

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
9 December 2004 (09.12.2004)

PCT

(10) International Publication Number  
**WO 2004/106383 A1**

(51) International Patent Classification<sup>7</sup>: C07K 16/30,  
16/28, A61K 39/395, 16/46

Patrick [DE/DE]; Waldpromenade 18C, 82131 Gauting  
(DE).

(21) International Application Number:  
PCT/EP2004/005687

(74) Agent: VOSSIUS & PARTNER; Siebertstrasse 4, 81675  
München (DE).

(22) International Filing Date: 26 May 2004 (26.05.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
03 01 2134.7 31 May 2003 (31.05.2003) EP  
03 01 2133.9 31 May 2003 (31.05.2003) EP

(71) Applicant (for all designated States except US): MI-  
CROMET AG [DE/DE]; Staffelseestrasse 2, 81477  
München (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): KUFER, Peter  
[DE/DE]; Am Kapellenacker 13, 85368 Moosburg (DE).  
BERRY, Meera [IN/DE]; Steingasse 10, 89073 Ulm (DE).  
OFFNER, Sonja [DE/DE]; Zamboninstr. 23, 80638  
München (DE). BRISCHWEIN, Klaus [DE/DE]; Licht-  
enfelsstrasse 18, 81243 Munich (DE). WOLF, Andreas  
[DE/DE]; Einsteinstr. 10, 82152 Planegg (DE). RAUM,  
Tobias [DE/DE]; Zentnerstrasse 20, 80789 München (DE).  
KOHLEISEN, Birgit [DE/DE]; Staffelseestr. 2, 81477  
München (DE). LENKKERI-SCHÜTZ, Ulla [FI/DE];  
Nelkenstrasse 23, 85386 Eching (DE). BÄUERLE,

(81) Designated States (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,  
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,  
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,  
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,  
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,  
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,  
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,  
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,  
ZW.

(84) Designated States (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,  
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,  
FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI,  
SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments

For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: PHARMACEUTICAL COMPOSITION COMPRISING A BISPECIFIC ANTIBODY FOR EPCAM

(57) Abstract: The present invention provides a pharmaceutical composition comprising a bispecific single chain antibody construct. Said bispecific single chain antibody construct is characterized to comprise or consist of at least two domains, whereby one of said at least two domains specifically binds to human EpCAM and comprises at least one CDR-H3 region comprising the amino acid sequence NXID antigen and a second domain binds to human CD3 antigen. The invention further provides a process for the production of the pharmaceutical composition of the invention, a method for the prevention, treatment or amelioration of a tumorous disease and the use of the disclosed bispecific single chain antibody construct and corresponding means in the prevention, treatment or amelioration of a tumorous disease.

WO 2004/106383 A1

AP20 Rec'd PCT/PTO 08 AUG 2006

PHARMACEUTICAL COMPOSITION COMPRISING  
A BISPECIFIC ANTIBODY SPECIFIC FOR EPCAM

5

The invention relates to a pharmaceutical composition comprising a bispecific single chain antibody construct. Said bispecific single chain antibody construct is characterized to comprise or consist of at least two domains, whereby one of said at least two domains specifically binds to human EpCAM antigen and comprises at least one CDR-H3 region comprising the amino acid sequence NXD and a second domain binds to human CD3 antigen. The invention further provides a process for the production of the pharmaceutical composition of the invention, a method for the prevention, treatment or amelioration of a tumorous disease and the use of the disclosed bispecific single chain antibody construct and corresponding means in the prevention, treatment or amelioration of a tumorous disease.

A variety of documents is cited throughout this specification. The disclosure content of said documents is herewith incorporated by reference.

Epithelial cell adhesion molecule (EpCAM, also called 17-1A antigen, KSA, EGP40, GA733-2, ks1-4 or esa) is a 40-kDa membrane-integrated glycoprotein of 314 amino acids with specific expression in certain epithelia and on many human carcinomas (reviewed in Balzar, J. Mol. Med. 1999, 77, 699-712). EpCAM was discovered and subsequently cloned through its recognition by the murine monoclonal antibody 17-1A/edrecolomab (Goettlinger, Int J Cancer. 1986; 38, 47-53 and Simon, Proc. Natl. Acad. Sci. USA. 1990; 87, 2755-2759). Monoclonal antibody 17-1A was generated by immunization of mice with human colon carcinoma cells (Koprowski, Somatic Cell Genet. 1979, 5, 957-971).

The EGF-like repeats of EpCAM were shown to mediate lateral and reciprocal interactions in homophilic cell adhesion (Balzar, Mol. Cell. Biol. 2001, 21, 2570-2580) and, for that reason, is predominantly located between epithelial cells (Litvinov, J Cell Biol. 1997, 139, 1337-1348, Balzar, J Mol Med. 1999, 77, 699-712 and Trebak, J Biol Chem. 2001, 276, 2299-2309). EpCAM serves to adhere epithelial cells in an oriented and highly ordered fashion (Litvinov, J Cell Biol. 1997, 139, 1337-1348). Data from experiments with transgenic mice and rats expressing human EpCAM on their epithelia suggest that EpCAM on normal tissue may however not be accessible to systemically administered antibody (McLaughlin, Cancer Immunol. Immunother., 1999, 48, 303-311). Upon malignant transformation of epithelial cells the rapidly growing tumor cells are abandoning the high cellular order of epithelia. Consequently, the surface distribution of EpCAM becomes less restricted and the molecule better exposed on tumor cells. Due to their epithelial cell origin, tumor cells from most carcinomas still express EpCAM on their surface.

In vivo, expression of EpCAM is related to increased epithelial proliferation and negatively correlates with cell differentiation (for review see Balzar, 1999, J. Mol. Med. 77, 699-712). Expression of EpCAM, as detected by immunohistochemistry using anti-EpCAM monoclonal antibodies, is essentially seen with all major carcinomas (reviewed in Balzar, J Mol Med. 1999, 77, 699-712). Best EpCAM expression was observed with non-small cell lung cancer (De Bree, Nucl Med Commun. 1994, 15, 613-27) and prostate cancer (Zhang, Clin Cancer Res. 1998, 4, 295-302) where 100% of tumor patient samples showed positive EpCAM staining. In these studies, EpCAM is also reported to homogeneously stained tumor tissues indicating that the antigen is expressed on a large proportion of cells of a given tumor. Because of its widespread expression, EpCAM is referred to as a "pan-carcinoma" antigen.

EpCAM has been shown in various studies to be beneficial in diagnosis and therapy of various carcinomas. Furthermore, in many cases, tumor cells were

observed to express EpCAM to a much higher degree than their parental epithelium or less aggressive forms of said cancers. For example, EpCAM expression was shown to be significantly higher on neoplastic tissue and in adenocarcinoma than on normal prostate epithelium (n=76; p<0.0001), suggesting that increased EpCAM expression represents an early event in the development of prostate cancer (Poczatek, J Urol., 1999, 162, 1462-1644). In addition, in the majority of both squamous and adenocarcinomas of the cervix a strong EpCAM expression correlates with an increased proliferation and the disappearance of markers for terminal differentiation (Litvinov, Am. J. Pathol. 1996, 148, 865-75). One example is breast cancer where overexpression of EpCAM on tumor cells is a predictor of survival (Gastl, Lancet. 2000, 356, 1981-1982). Furthermore, EpCAM has been described as a marker for the detection of disseminated tumor cells in patients suffering from squamous cell carcinoma of the head, neck and lung (Chaubal, Anticancer Res 1999, 19, 2237-2242, Piyathilake, Hum Pathol. 2000, 31, 482-487). Normal squamous epithelium, as found in epidermis, oral cavity, epiglottis, pharynx, larynx and esophagus did not significantly express EpCAM (Quak, Hybridoma, 1990, 9, 377-387).

In addition to the above-mentioned carcinomas, EpCAM has been shown to be expressed on the majority of primary, metastatic, and disseminated NSCLC (non small cell lung cancer cells) (Passlick, Int J Cancer, 2000, 87, 548-552), on gastric and gastro-oesophageal junction adenocarcinomas (Martin, J Clin Pathol 1999, 52, 701-4) and in cell lines derived from colorectal, pancreatic carcinomas and breast carcinomas (Szala, Proc Natl Acad Sci U S A 1990, 87, 3542-6, Packeisen, Hybridoma, 1999, 18, 37-40).

Clinical trials have shown that the use of antibodies directed against 17-1A (EpCAM) for treatment of patients with surgically completely resected colorectal carcinoma leads to a significant benefit concerning the overall survival and the frequency of distant metastasis (Riethmüller, Lancet, 1994, 343, 1177-1183). Murine monoclonal antibody against EpCAM was found to reduce the 5-year



mortality (Riethmüller, Lancet, 1994, 343, 1177-1183) and also the 7-year mortality (Riethmüller, Proceedings of the American Society of Clinical Oncology, 1996, 15, 444) of patients with minimal residual disease. Example of murine monoclonal antibody recognizing EpCAM is Edrecolomab (Panorex) (Koprowski, Somatic Cell Genet. 1979, 5, 957-971 and Herlyn, Cancer Res., 1980, 40, 717-721). However, the first administration of Panorex during adjuvant immunotherapy of colon cancer led to the development and exacerbation of Wegener's granulomatosis suggesting that mAb 17-1A should be applied cautiously in a patient with autoimmune disease (Franz, Onkologie, 2000, 23, 472-474). The limitations of Panorex are the rapid formation of human anti-mouse antibodies (HAMA), the limited ability to interact by its murine IgG2a Fc-portion with human immune effector mechanisms and the short half-life in circulation (Frodin, Cancer Res., 1990, 50, 4866-4871). Furthermore, the murine antibody caused immediate-type allergic reactions and anaphylaxis upon repeated injection in patients (Riethmüller, Lancet. 1994, 343, 1177-1183, Riethmüller, J Clin Oncol., 1998, 16, 1788-1794 and Mellstedt, Annals New York Academy of Sciences. 2000, 910, 254-261).

Humanized anti-EpCAM antibody called 3622W94 resulted in pancreatitis and increased serum levels of amylase, as being indicative for damage of pancreas epithelium, which were a dose-limiting toxicity of this high-affinity anti-EpCAM monoclonal antibody (LoBuglio, Proceedings of the American Society of Clinical Oncology (Abstract). 1997, 1562 and Khor, Proceedings of the American Society of Clinical Oncology (Abstract), 1997, 847).

Bispecific antibodies comprising a region directed against EpCAM and a region directed against CD3 have also been described. The authors of Möller & Reisfeld 1991 Cancer Immunol. Immunother. 33:210-216 describe the construction of two different bispecific antibodies by fusing a hybridoma producing monoclonal antibody against EpCAM with either of the two hybridomas OKT3 and 9.3. Furthermore, Kroesen, Cancer Research, 1995, 55:4409-4415 describe a

quadroma bispecific monoclonal antibodies against CD3 (BIS-1) and EpCAM.

Other examples of bispecific antibodies against EpCAM comprise the bispecific antibody, BiUll, (anti-CD3 (rat IgG2b) x anti-EpCAM (mouse IgG2a)) a complete Ig molecule which also binds and activates Fc-receptor positive accessory cells (like monocytes/macrophages, NK cells and dendritic cells) through its Fc-region (Zeidler, J. Immunol., 1999, 163:1247-1252) and an anti-EpCAMxanti-CD3 bispecific antibody in the arrangement  $V_{L17-1A}-V_{H17-1A}-V_{Hanti-CD3}-V_{Lanti-CD3}$  (Mack, Proc. Natl. Acad. Sci., 1995, 92:7021-7025).

In addition, other formats of antibody constructs comprising EpCAM have been described; e.g. a bispecific diabody having the structure  $V_H anti-CD3-V_L anti-EpCAM-V_H anti-EpCAM-V_L anti-CD3$  (Helfrich, Int. J. Cancer, 1998, 76:232-239) and a trispecific antibody having two different tumour antigen specificities (two antigen binding regions which bind two different antigens on a tumour cell) and which may have a further specificity for an antigen localized on an effector cell (DE 195 31 348).

There exist various descriptions in the prior art of using phage display technology to identify antibodies or fragments thereof, which specifically bind to the human EpCAM antigen (De Kruif JMB, 1995, 248:97-105, WO 99/25818). However, it has been extremely difficult to identify antibodies against EpCAM, which show cytotoxic activity sufficient for therapeutic applications in a bispecific format.

It is therefore an aim of the present invention to provide a bispecific single chain molecule with a binding domain specific for EpCAM with strong cytotoxic activity mediated by target specific activation of T cells.

Thus, the technical problem underlying the present invention was to provide means

and methods for the generation of well tolerated and convenient medicaments for the treatment and or amelioration of tumorous diseases.

5 The solution to said technical problem is achieved by providing the embodiments characterized in the claims.

10 Accordingly, the present invention relates to a composition, preferably a pharmaceutical composition, comprising a bispecific single chain antibody construct, whereby said construct comprises or consists of at least two binding domains, whereby one of said domains binds to human EpCAM antigen and a second domain binds to human CD3 antigen, wherein said binding domain specific for EpCAM comprises at least one CDR-H3 region comprising the amino acid sequence NXD preferably in position 102 to 104 of SEQ ID NOs: 80, 88 and 96, or preferably in position 106 to 108 of SEQ ID NOs: 84 and 92, wherein X is an aromatic amino acid.

15 Preferably or alternatively, the present invention relates to a composition, preferably a pharmaceutical composition, comprising a bispecific single chain antibody construct, whereby said construct comprises or consists of at least two domains, whereby one of said at least two domains specifically binds to human EpCAM antigen and a second domain binds to human CD3 antigen, wherein said binding domain specific for EpCAM comprises at least one CDR-H3 region of least 9 amino acid residues and wherein said binding domain specific for EpCAM has a  $K_D$  value of more than  $5 \times 10^{-9}$  M.

25 In accordance with this invention, the term "pharmaceutical composition" relates to a composition for administration to a patient, preferably a human patient. In a preferred embodiment, the pharmaceutical composition comprises a composition for parenteral, transdermal, intraluminal, intra-arterial, intrathecal or intravenous administration or for direct injection into the tumor. It is in particular envisaged that  
30 said pharmaceutical composition is administered to a patient via infusion or injection. Administration of the suitable compositions may be effected by different

ways, e.g., by intravenous; subcutaneous, intraperitoneal, intramuscular, topical or intradermal administration. The pharmaceutical composition of the present invention may further comprise a pharmaceutically acceptable carrier. Examples of suitable pharmaceutical carriers are well known in the art and include phosphate buffered saline solutions, water, emulsions, such as oil/water emulsions, various types of wetting agents, sterile solutions, etc. Compositions comprising such carriers can be formulated by well known conventional methods. These pharmaceutical compositions can be administered to the subject at a suitable dose. The dosage regimen will be determined by the attending physician and clinical factors. As is well known in the medical arts, dosages for any one patient depends upon many factors, including the patient's size, body surface area, age, the particular compound to be administered, sex, time and route of administration, general health, and other drugs being administered concurrently. A preferred dosage for administration might be in the range of 0.24  $\mu$ g to 48 mg, preferably 0.24  $\mu$ g to 24 mg, more preferably 0.24  $\mu$ g to 2.4 mg, even more preferably 0.24  $\mu$ g to 1.2 mg and most preferably 0.24  $\mu$ g to 240  $\mu$ g units per kilogram of body weight per day. Particularly preferred dosages are recited herein below. Progress can be monitored by periodic assessment. Dosages will vary but a preferred dosage for intravenous administration of DNA is from approximately  $10^6$  to  $10^{12}$  copies of the DNA molecule. The compositions of the invention may be administered locally or systematically. Administration will generally be parenteral, e.g., intravenous; DNA may also be administered directly to the target site, e.g., by biolistic delivery to an internal or external target site or by catheter to a site in an artery. In an preferred embodiment, the pharmaceutical composition is administered subcutaneously and in an even more preferred embodiment intravenously. Preparations for parenteral administration include sterile aqueous or non-aqueous solutions, suspensions, and emulsions. Examples of non-aqueous solvents are propylene glycol, polyethylene glycol, vegetable oils such as olive oil, and injectable organic esters such as ethyl oleate. Aqueous carriers include water, alcoholic/aqueous solutions, emulsions or suspensions, including saline and buffered media. Parenteral vehicles include sodium chloride solution, Ringer's dextrose, dextrose and sodium chloride, lactated



Ringer's, or fixed oils. Intravenous vehicles include fluid and nutrient replenishes, electrolyte replenishers (such as those based on Ringer's dextrose), and the like. Preservatives and other additives may also be present such as, for example, antimicrobials, anti-oxidants, chelating agents, and inert gases and the like. In addition, the pharmaceutical composition of the present invention might comprise proteinaceous carriers, like, e.g., serum albumine or immunoglobuline, preferably of human origin. It is envisaged that the pharmaceutical composition of the invention might comprise, in addition to the proteinaceous bispecific single chain antibody constructs or nucleic acid molecules or vectors encoding the same (as described in this invention), further biologically active agents, depending on the intended use of the pharmaceutical composition. Such agents might be drugs acting on the gastro-intestinal system, drugs acting as cytostatica, drugs preventing hyperurikemia, agents such as T-cell co-stimulatory molecules or cytokines, drugs inhibiting immune reactions (e.g. corticosteroids) and/or drugs acting on the circulatory system, e.g. on the blood pressure, known in the art.

Possible indications for administration of the composition(s) of the invention are tumorous diseases especially epithelial cancers/carcinomas such as breast cancer, colon cancer, prostate cancer, head and neck cancer, skin cancer, cancers of the genito-urinary tract, e.g. ovarian cancer, endometrial cancer, cervix cancer and kidney cancer, lung cancer, gastric cancer, cancer of the small intestine, liver cancer, pancreas cancer, gall bladder cancer, cancers of the bile duct, esophagus cancer, cancer of the salivary glands and cancer of the thyroid gland. The administration of the composition(s) of the invention is especially indicated for minimal residual disease preferably early solid tumor, advanced solid tumor or metastatic solid tumor, which is characterized by the local and non-local reoccurrence of the tumor caused by the survival of single cells.

The invention further envisages the co-administration protocols with other compounds, e.g. bispecific antibody constructs, targeted toxins or other compounds, which act via T cells. The clinical regimen for co-administration of the inventive compound(s) may encompass co-administration at the same time, before or after the administration of the other component.

A possible approach to demonstrate the efficacy/activity of the inventive constructs is an in vivo model like mouse. Suitable models may be transgenic and chimeric mouse models. Mouse models expressing human CD3 and human EpCAM, a chimeric mouse model expressing murine CD3 and into which tumour cells  
5 expressing human EpCAM can be transfected and chimeric mouse models comprising nude mice into which human tumours expressing EpCAM can be transplanted or tumour cells expressing human EpCAM can be injected and, additionally, human PBMCs are injected. The term "bispecific single chain antibody construct" relates to a construct comprising two antibody derived binding domains.  
10 One of said binding domains consists of variable regions (or parts thereof) of an antibody, antibody fragment or derivative thereof, capable of specifically binding to/interacting with human EpCAM antigen (target molecule 1). The second binding domain consists of variable regions (or parts thereof) of an antibody, antibody fragment or derivative thereof, capable of specifically binding to/interacting with  
15 human CD3 antigen (target molecule 2). As will be detailed below, a part of a variable region may be at least one CDR ("Complementary determining region"), most preferably at least the CDR3 region. Said two domains/regions in the single chain antibody construct are preferably covalently connected to one another as a single chain. This connection can be effected either directly (domain 1 [specific for  
20 the CD3 antigen] – domain 2 [specific for the EpCAM antigen] or domain 1 [specific for the EpCAM antigen] – domain 2 [specific for the CD3 antigen]) or through an additional polypeptide linker sequence (domain1 – linker sequence – domain2). In the event that a linker is used, this linker is preferably of a length and sequence sufficient to ensure that each of the first and second domains can, independently  
25 from one another, retain their differential binding specificities. Most preferably and as documented in the appended examples, the "bispecific single chain antibody construct" to be employed in the pharmaceutical composition of the invention is a bispecific single chain Fv (scFv). Bispecific single chain molecules are known in the art and are described in WO 99/54440, Mack, J. Immunol. (1997), 158, 3965-  
30 3970, Mack, PNAS, (1995), 92, 7021-7025, Kufer, Cancer Immunol. Immunother., (1997), 45, 193-197, Löffler, Blood, (2000), 95, 6, 2098-2103 and Brühl, J.

Immunol., (2001), 166, 2420-2426. A particularly preferred molecular format of the invention provides a polypeptide construct wherein the antibody-derived region comprises one  $V_H$  and one  $V_L$  region. The intramolecular orientation of the  $V_H$ -domain and the  $V_L$ -domain, which are linked to each other by a linker-domain, in the scFv format is not decisive for the recited bispecific single chain constructs. Thus, scFvs with both possible arrangements ( $V_H$ -domain – linker domain –  $V_L$ -domain;  $V_L$ -domain – linker domain –  $V_H$ -domain) are particular embodiments of the recited bispecific single chain construct.

The antibody construct may also comprise additional domains, e.g. for the isolation and/or preparation of recombinantly produced constructs.

A corresponding format for a bispecific single chain antibody construct is described in the appended example 1.

The term "single-chain" as used in accordance with the present invention means that said first and second domain of the bispecific single chain construct are covalently linked, preferably in the form of a co-linear amino acid sequence encodable by a single nucleic acid molecule.

The term "binding to/interacting with" as used in the context with the present invention defines a binding/interaction of at least two "antigen-interaction-sites" with each other. The term "antigen-interaction-site" defines, in accordance with the present invention, a motif of a polypeptide which shows the capacity of specific interaction with a specific antigen or a specific group of antigens. Said binding/interaction is also understood to define a "specific recognition". The term "specifically recognizing" means in accordance with this invention that the antibody molecule is capable of specifically interacting with and/or binding to at least two amino acids of each of the human target molecule as defined herein. Said term relates to the specificity of the antibody molecule, i.e. to its ability to discriminate between the specific regions of the human target molecule as defined herein. The specific interaction of the antigen-interaction-site with its specific antigen may result in an initiation of a signal, e.g. due to the induction of a change of the conformation of the antigen, an oligomerization of the antigen, etc. Further, said binding may be

exemplified by the specificity of a "key-lock-principle". Thus, specific motifs in the amino acid sequence of the antigen-interaction-site and the antigen bind to each other as a result of their primary, secondary or tertiary structure as well as the result of secondary modifications of said structure. The specific interaction of the antigen-interaction-site with its specific antigen may result as well in a simple binding of said site to the antigen.

The term "specific interaction" as used in accordance with the present invention means that the bispecific single chain construct does not or essentially does not cross-react with (poly)peptides of similar structures. Cross-reactivity of a panel of bispecific single chain construct under investigation may be tested, for example, by assessing binding of said panel of bispecific single chain construct under conventional conditions (see, e.g., Harlow and Lane, Antibodies: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 1988 and Using Antibodies: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 1999) to the (poly)peptide of interest as well as to a number of more or less (structurally and/or functionally) closely related (poly)peptides. Only those antibodies that bind to the (poly)peptide/protein of interest but do not or do not essentially bind to any of the other (poly)peptides are considered specific for the (poly)peptide/protein of interest. Examples for the specific interaction of an antigen-interaction-site with a specific antigen comprise the specificity of a ligand for its receptor. Said definition particularly comprises the interaction of ligands which induce a signal upon binding to its specific receptor. Examples for corresponding ligands comprise cytokines which interact/bind with/to its specific cytokine-receptors. Also particularly comprised by said definition is the binding of an antigen-interaction-site to antigens like antigens of the selectin family, integrins and of the family of growth factors like EGF. An other example for said interaction, which is also particularly comprised by said definition, is the interaction of an antigenic determinant (epitope) with the antigenic binding site of an antibody.

The term "binding to/interacting with" may also relate to a conformational epitope, a structural epitope or a discontinuous epitope consisting of two regions of the human target molecules or parts thereof. In context of this invention, a



conformational epitope is defined by two or more discrete amino acid sequences separated in the primary sequence which come together on the surface of the molecule when the polypeptide folds to the native protein (Sela, (1969) Science 166, 1365 and Laver, (1990) Cell 61, 553-6).

5 The term "discontinuous epitope" means in context of the invention non-linear epitopes that are assembled from residues from distant portions of the polypeptide chain. These residues come together on the surface of the molecule when the polypeptide chain folds into a three-dimensional structure to constitute a conformational/structural epitope.

10 The constructs of the present invention are also envisaged to specifically bind to/interact with a conformational/structural epitope(s) composed of and/or comprising the two regions of the human CD3 complex described herein or parts thereof as disclosed herein below.

Accordingly, specificity can be determined experimentally by methods known in the art and methods as disclosed and described herein. Such methods comprise, but  
15 are not limited to Western blots, ELISA-, RIA-, ECL-, IRMA-, EIA-tests and peptide scans.

The term "antibody fragment or derivative thereof" relates to single chain antibodies, or fragments thereof, synthetic antibodies, antibody fragments, such as  
20 Fab, a F(ab<sub>2</sub>)', Fv or scFv fragments etc., or a chemically modified derivative of any of these. Antibodies to be employed in accordance with the invention or their corresponding immunoglobulin chain(s) can be further modified using conventional techniques known in the art, for example, by using amino acid deletion(s), insertion(s), substitution(s), addition(s), and/or recombination(s) and/or any other  
25 modification(s) (e.g. posttranslational and chemical modifications, such as glycosylation and phosphorylation) known in the art either alone or in combination. Methods for introducing such modifications in the DNA sequence underlying the amino acid sequence of an immunoglobulin chain are well known to the person skilled in the art; see, e.g., Sambrook (1989), loc. cit.

30 The term "(poly)peptide" as used herein describes a group of molecules which comprise the group of peptides, as well as the group of polypeptides. The group of

peptides is consisting of molecules with up to 30 amino acids, the group of polypeptides is consisting of molecules with more than 30 amino acids.

The term "antibody fragment or derivative thereof" particularly relates to (poly)peptide constructs comprising at least one CDR.

- 5 Fragments or derivatives of the recited antibody molecules define (poly)peptides which are parts of the above antibody molecules and/or which are modified by chemical/biochemical or molecular biological methods. Corresponding methods are known in the art and described inter alia in laboratory manuals (see Sambrook et al.; Molecular Cloning: A Laboratory Manual; Cold Spring Harbor Laboratory Press, 10 2nd edition 1989 and 3rd edition 2001; Gerhardt et al.; Methods for General and Molecular Bacteriology; ASM Press, 1994; Lefkovits; Immunology Methods Manual: The Comprehensive Sourcebook of Techniques; Academic Press, 1997; Golemis; Protein-Protein Interactions: A Molecular Cloning Manual; Cold Spring Harbor Laboratory Press, 2002).

15

Bispecific antibodies that specifically recognize the EpCAM antigen and the CD3 antigen are described in the prior art, e.g., in Mack (Proc. Natl. Acad. Sci., 1995, 92:7021-7025).

- 20 As mentioned above, the said variable domains comprised in the herein described bispecific single chain constructs are connected by additional linker sequences. The term "peptide linker" defines in accordance with the present invention an amino acid sequence by which the amino acid sequences of the first domain and the second domain of the defined construct are linked with each other. An essential 25 technical feature of such peptide linker is that said peptide linker does not comprise any polymerization activity. A particularly preferred peptide linker is characterized by the amino acid sequence Gly-Gly-Gly-Gly-Ser, i.e. (Gly)<sub>4</sub>Ser, or polymers thereof, i.e. ((Gly)<sub>4</sub>Ser)<sub>x</sub>. The characteristics of said peptide linker, which comprise the absence of the promotion of secondary structures are known in the art and 30 described e.g. in Dall'Acqua et al. (Biochem. (1998) 37, 9266-9273), Cheadle et al. (Mol Immunol (1992) 29, 21-30) and Raag and Whitlow (FASEB (1995) 9(1), 73-

80). Also particularly preferred are peptide linkers which comprise less amino acid residues. An envisaged peptide linker with less than 5 amino acids can comprise 4, 3, 2 or one amino acids. A particularly preferred "single" amino acid in context of said "peptide linker" is Gly. Accordingly, said peptide linker may consist of the single amino acid Gly. Furthermore, peptide linkers which also do not promote any secondary structures are preferred. The linkage of said domains to each other can be provided by, e.g. genetic engineering, as described in the examples. Methods for preparing fused and operatively linked bispecific single chain constructs and expressing them in mammalian cells or bacteria are well-known in the art (e.g. WO 99/54440, Ausubel, Current Protocols in Molecular Biology, Green Publishing Associates and Wiley Interscience, N.Y. 1989 and 1994 or Sambrook et al., Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, 2001).

The bispecific single chain antibody constructs described herein above and below may be humanized or deimmunized antibody constructs. Methods for the humanization and/or deimmunization of (poly))peptides and, in particular, antibody constructs are known to the person skilled in the art.

Here it was surprisingly found that domains with specificity for the EpCAM antigen, comprising at least one CDR-H3 region comprising the amino acid sequence NXD (asparagine-X-aspartic acid) preferably in position 102 to 104 of SEQ ID NOs: 80, 88 and 96, or in position 106 to 108 of SEQ ID NOs: 84 and 92, wherein X is an aromatic amino acid are particularly useful in the specific format of a bispecific single chain antibody construct. These bispecific single chain antibody constructs are particularly useful as pharmaceutical compositions since these constructs are advantageous over constructs which do not comprise said amino acids.

Furthermore, it was surprisingly found that domains with specificity for the EpCAM antigen, comprising at least one CDR-H3 region of at least 9 amino acid residues and having a  $K_D$  value of more than  $5 \times 10^{-9}$  M are particularly useful in the specific format of a bispecific single chain antibody construct. These bispecific single chain

antibody construct are particularly useful as pharmaceutical compositions since these constructs are advantageous over constructs of less than 9 amino acid residues and wherein said binding domain specific for EpCAM has a  $K_D$  value of less than  $5 \times 10^{-9}$  M.

5

The prior art constructs are characterized by less advantageous  $EC_{50}$  values and/or less efficient or complete purifications as shown in the appended examples. It was in particular surprising that the domain of the single chain constructs with specificity for the CD3 antigen to be employed in accordance with the invention are highly bioactive in N- as well as C-terminal position, wherein in particular arrangements in  $V_{H(\text{anti-CD3})}$ - $V_{L(\text{anti-CD3})}$  are preferred. The constructs to be employed in the pharmaceutical composition of the invention are characterized by advantageous production and purification properties as well as by their high bioactivity, i.e. their desired cytotoxic activity. In particular, when the cytotoxic activity of the constructs of the invention were compared with cytotoxic activity of conventional M79xanti-CD3 and HD70xanti-CD3 constructs, the constructs of the invention showed clearly higher bioactivity (Figure 11B). The corresponding high bioactivity is reflected by low to very low  $EC_{50}$  values as determined in cytotoxicity tests. The lower the  $EC_{50}$  value of the molecule is, the higher cytotoxicity, i.e. the effectivity in the cell lysis, of the construct is higher. On the other hand, the higher the  $EC_{50}$  value, the less effective the molecule is in inducing cell lysis. The term "EC<sub>50</sub>" corresponds, in context of this invention, to  $EC_{50}$  values as determined according to the methods known in the art and as illustrated in the appended examples: A standard dose-response curve is defined by four parameters: the baseline response (Bottom), the maximum response (Top), the slope, and the drug concentration that provokes a response halfway between baseline and maximum ( $EC_{50}$ ).  $EC_{50}$  is defined as the concentration of a drug or molecule that provokes a response half way between the baseline (Bottom) and maximum response (Top). A lower  $K_D$  value of the constructs of the invention depicts higher binding affinity. E.g. a low  $K_D$  of  $10^{-9}$  M shows high binding affinity of the binding construct. On the other hand a high  $K_D$  value of e.g.  $10^{-6}$  M relates to lower binding affinity of the binding



domain of the construct.

The percentage of cell lysis (i.e. cytotoxic activity) may be determined by, inter alia, release assays disclosed herein above, for example,  $^{51}\text{Cr}$  release assays, LDH-release assays and the like. Most preferably, in context of this invention  
5 fluorochrome release assays is employed as illustrated in the appended examples. Here, strong cytotoxic activity against EpCAM-positive cells (see CHO-EpCAM cells in appended example 3) of the bispecific single chain constructs described herein relates to a molecule comprising  $\text{EC}_{50}$  values preferably  $\leq 500$  pg/ml, more preferably  $\leq 400$  pg/ml, even more preferably  $\leq 300$  pg/ml, even more preferably  $\leq$   
10 250 pg/ml, most preferably  $\leq 200$  pg/ml  $\leq 100$  pg/ml,  $\leq 50$  pg/ml.

The bispecific constructs comprised in the pharmaceutical compositions of the present invention show a surprisingly high cytotoxic activity (preferably in the range of about 10 pg/ml to 170 pg/ml) compared to the prior art M79xanti-CD3 construct  
15 (VL<sub>17-1A</sub>- VH<sub>17-1A</sub>- VH<sub>CD3</sub>- VL<sub>CD3</sub>; 8628 pg/ml). A skilled person is aware that  $\text{EC}_{50}$  values may vary depending to the bioactivity assay. Factors affecting  $\text{EC}_{50}$  value may comprise type of effector cells, activity of effector cells, type of target cells, E:T ratio, incubation time, incubation temperature and other external circumstances. Different  $\text{EC}_{50}$  values of same constructs in different experiments may be  
20 compared with the  $\text{EC}_{50}$  values of controls. A construct having high cytotoxic activity according to the invention has at least 2.5 time lower  $\text{EC}_{50}$  value than the control (at least 2.5 times higher cytotoxicity than the control), preferably at least three times lower  $\text{EC}_{50}$  value and more preferably at least five times lower  $\text{EC}_{50}$  value.

25 Furthermore, the constructs of the invention bind EpCAM with a surprisingly high affinity measured by surface plasmon resonance (BIAcore®). The prior art EpCAM and CD3 binding construct M79xanti-CD3 has a  $K_D$  of  $4 \times 10^{-6}$  M and the constructs of the invention a  $K_D$  of  $2,3 \times 10^{-7} - 2,5 \times 10^{-7}$  M.

30 Preferably, the X in said NXD motif is W (tryptophan) or Y (tyrosine).

It is further envisaged that the pharmaceutical composition of the invention comprises a bispecific single chain antibody construct, wherein the CDR-H3 of the EpCAM specific domain comprises at least 9 amino acid residues, preferably at least 14 amino acids. Preferably the CDR-H3 comprises less than 18 amino acids, more preferably less than 15 amino acids. Thus, preferably the CDR-H3 comprises 9 to 17 amino acids, more preferably 9 to 15 amino acids and most preferably 10 or 14 amino acids.

Bispecific single chain antibody construct comprising a corresponding EpCAM specific domain have been surprisingly found to be advantageous in the format of the above described construct over other EpCAM specific domain known in the art. Such effect is demonstrated in appended examples 3, 4 and 5. The prior art EpCAM binding antibody M79 comprises eight amino acids in its CDR-H3 region and does not comprise the sequence NXD (Figure 11A).

The pharmaceutical composition according to the invention may also comprise constructs, wherein said binding domain specific for EpCAM has a  $K_D$  value of more than  $5 \times 10^{-9}$  M.

The pharmaceutical composition may additionally be characterized by the feature that said binding domain specific for the CD3 antigen has a  $K_D$  value of more than  $10^{-7}$  M.

The  $K_D$  value is a physical value defining the tendency of a complex to dissociate. For the binding equilibrium  $A+B \leftrightarrow AB$ , the dissociation constant is given as the ratio of the two kinetic rate constants  $k_{off}$  and  $k_{on}$ :  $[A][B] (k_{on})/[AB] (k_{off})$ . The smaller the dissociation constant the tighter A and B bind to each other. In biological systems a good, specific binder has a dissociation constant in the range of  $10^{-9}$ - $10^{-7}$  M.  $K_D$  can be measured with a number of methods known to the person skilled in the art, e.g. surface plasmon resonance (SPR, e.g. with BIAcore®), analytical ultracentrifugation, isothermal titration calorimetry, fluorescence anisotropy, fluorescence spectroscopy or by radiolabeled ligand binding assays.

The  $K_D$ s of the constructs of the invention have been measured using the surface

plasmon resonance (SPR) spectroscopy. The ligand is injected over the immobilized antigen chip surface and the change in optical density on the chip surface upon binding is measured. The change in optical density, monitored by a change in reflection angle, correlates directly to the amount of ligand binding to the chip surface - the biophysical phenomenon used is called surface plasmon resonance.

One of the interaction partners has to be immobilized on the surface of the sensor chip of the apparatus based on surface plasmon resonance (e.g. BIAcore®). The kinetics of association and dissociation of ligand with the immobilized antigen on the chip surface are observed in real time. The binding curves are fitted for kinetic rate constants  $k_{on}$  and  $k_{off}$ , resulting in an apparent equilibrium dissociation constant ( $K_D$ ).

It is particularly preferred, that said binding domain specific for EpCAM has a  $K_D$  value in a range between  $1 \times 10^{-7}$  and  $5 \times 10^{-9}$  M and said binding domain specific for CD3 has a  $K_D$  value in a range between  $1 \times 10^{-6}$  and  $5 \times 10^{-9}$  M.

In a particularly preferred embodiment, the pharmaceutical composition may additionally be characterized by the feature that said binding domain specific for the CD3 antigen has a  $K_D$  value of  $> (more\ than)\ 1 \times 10^{-7}$  M.

The constructs of the invention have the advantage that they may be used a number of times for killing tumour cells since the EpCAM binding part has an affinity with a  $K_D$  value of more than  $5 \times 10^{-9}$  M. If the affinity of a bispecific construct for binding an EpCAM-expressing tumour cell is too high, the construct binds one EpCAM expressing tumour cell and remains on its surface even when it has been killed and cannot continue to another tumour cell to be killed. A further advantage of the construct of the invention is that the binding domain specific for EpCAM binds with a high affinity (corresponds to lower  $K_D$  value), thus leading the circulating T-cells to the tumour cells marked with the bispecific construct. Therefore, the  $K_D$  of the binding domain specific for EpCAM of the bispecific construct is preferably in the range of  $10^{-7}$ - $5 \times 10^{-9}$  M and the  $K_D$  of the binding

domain specific for CD3 is preferably in the range of  $10^{-6}$  -  $5 \times 10^{-9}$  M. In a preferred embodiment, the KD value of the EpCAM binding domain is lower than the KD value of the CD3 binding domain corresponding to a higher affinity of the EpCAM binding domain compared to the CD3 binding domain.

5

Further it is envisaged that the pharmaceutical composition of the invention comprises a bispecific single chain antibody construct, wherein the CDR-H3 of the EpCAM specific domain comprises at least 9 amino acids, preferably at least 14 amino acids. Preferably the CDR-H3 comprises less than 18 amino acids, more preferably less than 15 amino acids. Thus, preferably the CDR-H3 comprises 9 to 17 amino acids, more preferably 9 to 15 amino acids and most preferably 10 or 14 amino acids.

In a preferred embodiment of the pharmaceutical composition of the invention the  $V_H$  chain of the domain specific for human EpCAM antigen is selected from the group consisting of:

- (a) an amino acid sequence as shown in any of SEQ ID NO: 80, SEQ ID NO: 84, SEQ ID NO: 88, SEQ ID NO: 92 and SEQ ID NO: 96;
- (b) an amino acid sequence encoded by a nucleic acid sequence as shown in SEQ ID NO: 79, SEQ ID NO: 83, SEQ ID NO: 87, SEQ ID NO: 91 and SEQ ID NO: 95 ;
- (c) an amino acid sequence encoded by a nucleic acid sequence hybridizing with the complementary strand of a nucleic acid sequence as defined in (b) under stringent hybridization conditions;
- (d) an amino acid sequence encoded by a nucleic acid sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (b) and (c).

The term "hybridizing" as used herein refers to polynucleotides/nucleic acid sequences which are capable of hybridizing to the polynucleotides encoding bispecific single chain constructs as defined herein or parts thereof. Therefore, said polynucleotides may be useful as probes in Northern or Southern Blot analysis of



RNA or DNA preparations, respectively, or can be used as oligonucleotide primers in PCR analysis dependent on their respective size. Preferably, said hybridizing polynucleotides comprise at least 10, more preferably at least 15 nucleotides in length while a hybridizing polynucleotide of the present invention to be used as a probe preferably comprises at least 100, more preferably at least 200, or most preferably at least 500 nucleotides in length.

It is well known in the art how to perform hybridization experiments with nucleic acid molecules, i.e. the person skilled in the art knows what hybridization conditions s/he has to use in accordance with the present invention. Such hybridization conditions are referred to in standard text books such as Molecular Cloning A Laboratory Manual, Cold Spring Harbor Laboratory (2001) N.Y. Preferred in accordance with the present inventions are polynucleotides which are capable of hybridizing to the polynucleotides of the invention or parts thereof, under stringent hybridization conditions.

"Stringent hybridization conditions" refer, e.g. to an overnight incubation at 42°C in a solution comprising 50% formamide, 5x SSC (750 mM NaCl, 75 mM sodium citrate), 50 mM sodium phosphate (pH 7.6), 5x Denhardt's solution, 10% dextran sulfate, and 20 µg/ml denatured, sheared salmon sperm DNA, followed by washing the filters in 0.1 x SSC at about 65°C. Also contemplated are nucleic acid molecules that hybridize to the polynucleotides of the invention at lower stringency hybridization conditions. Changes in the stringency of hybridization and signal detection are primarily accomplished through the manipulation of formamide concentration (lower percentages of formamide result in lowered stringency); salt conditions, or temperature. For example, lower stringency conditions include an overnight incubation at 37°C in a solution comprising 6X SSPE (20X SSPE = 3M NaCl; 0.2M NaH<sub>2</sub>PO<sub>4</sub>; 0.02M EDTA, pH 7.4), 0.5% SDS, 30% formamide, 100 µg/ml salmon sperm blocking DNA; followed by washes at 50°C with 1 X SSPE, 0.1% SDS. In addition, to achieve even lower stringency, washes performed following stringent hybridization can be done at higher salt concentrations (e.g. 5X SSC). It is of note that variations in the above conditions may be accomplished through the inclusion and/or substitution of alternate blocking reagents used to

suppress background in hybridization experiments. Typical blocking reagents include Denhardt's reagent, BLOTTO, heparin, denatured salmon sperm DNA, and commercially available proprietary formulations. The inclusion of specific blocking reagents may require modification of the hybridization conditions described above, due to problems with compatibility.

The recited nucleic acid molecules may be, e.g., DNA, cDNA, RNA or synthetically produced DNA or RNA or a recombinantly produced chimeric nucleic acid molecule comprising any of those polynucleotides either alone or in combination.

10 Preferably said pharmaceutical composition of the invention may comprise a bispecific single chain construct, wherein the  $V_L$  chain domains specific for human EpCAM antigen is selected from the group consisting of:

(a) an amino acid sequence as shown in any of SEQ ID NO: 82, SEQ ID NO: 86, SEQ ID NO: 90, SEQ ID NO: 94 and SEQ ID NO: 98;

15 (b) an amino acid sequence encoded by a nucleic acid sequence as shown in SEQ ID NO: 81, SEQ ID NO: 85, SEQ ID NO: 89, SEQ ID NO: 93 and SEQ ID NO: 97 ;

(c) an amino acid sequence encoded by a nucleic acid sequence hybridizing with the complementary strand of a nucleic acid sequence as defined in (b) under stringent hybridization conditions;

20 (d) an amino acid sequence encoded by a nucleic acid sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (b) and (c).

25 In a preferred embodiment of the pharmaceutical composition of this invention, the  $V_H$  and  $V_L$  regions of said human CD3 specific domain are derived from an CD3 specific antibody selected from the group consisting of X35-3, VIT3, BMA030 (BW264/56), CLB-T3/3, CRIS7, YTH12.5, F111-409, CLB-T3.4.2, TR-66, WT32, SPv-T3b, 11D8, XIII-141, XIII-46, XIII-87, 12F6, T3/RW2-8C8, T3/RW2-4B6, 30 OKT3D, M-T301, SMC2, WT31 and F101.01. These CD3-specific antibodies are well known in the art and, inter alia, described in Tunnaclyffe (1989), Int. Immunol.

1, 546-550. In a more preferred embodiment, said  $V_H$  and  $V_L$  regions of said CD3 specific domain are derived from OKT-3 (as defined and described above). Even more preferred (and as illustrated in the appended examples) said  $V_H$  and  $V_L$  regions are or are derived from an antibody/antibody derivative with specificity for the CD3 molecule described by Traunecker (1991), EMBO J. 10, 3655-3659. In accordance with this invention, said  $V_H$  and  $V_L$  regions are derived from antibodies/antibody derivatives and the like which are capable of specifically recognizing the human CD3- $\epsilon$  chain in the context of other TCR subunits, e.g. in mouse cells transgenic for human CD3- $\epsilon$  chain. These transgenic mouse cells express human CD3- $\epsilon$  chain in a native or near native conformation. Accordingly, the  $V_H$  and  $V_L$  regions derived from an CD3- $\epsilon$  chain specific antibody is most preferred in accordance with this invention and said (parental) antibodies should be capable of specifically binding epitopes reflecting the native or near native structure or a conformational epitope of human CD3 presented in context of the TCR complex. Such antibodies have been classified by Tunncliffe (1989) as "group II" antibodies. Further classifications in Tunncliffe (1989) comprise the definition of "group I" and "group III" antibodies directed against CD3. "Group I" antibodies, like UCHT1, recognize CD3- $\epsilon$  chain expressed as recombinant protein and as part of the TCR on the cell surface. Therefore, "group I" antibodies are highly specific for CD3- $\epsilon$  chain. In contrast, the herein preferred "group II antibodies" recognize CD3- $\epsilon$  chain only in the native TCR complex in association with other TCR subunits. Without being bound by theory, it is speculated in context of this invention that in "group II" antibodies, the TCR context is required for recognition of CD3- $\epsilon$  chain. CD3- $\gamma$  chain and  $\delta$  chain, being associated with  $\epsilon$  chain, are also involved in binding of "group II antibodies". All three subunits express immunoreceptor-tyrosine activation motifs (ITAMs) which can be tyrosine phosphorylated by protein tyrosine-based kinases. For this reason group II antibodies induce T cell signaling via CD3- $\epsilon$  chain,  $\gamma$  chain and  $\delta$  chain, leading to a stronger signal compared to group I antibodies selectively inducing T cell signaling via CD3- $\epsilon$  chain. Yet, since for therapeutic applications induction of a strong T cell signaling is desired, the  $V_H$  (anti-CD3) /  $V_L$  (anti-CD3)- regions (or parts thereof) to be employed in the bispecific single

chain constructs comprised in the inventive pharmaceutical composition, are preferably derived from antibodies directed against human CD3 and classified in "group II" by Tunnacliffe (1989), loc.cit.

- 5 In one embodiment the present invention relates to a pharmaceutical composition wherein said bispecific single chain antibody construct comprises an amino acid sequence selected from the group of:
- (a) an amino acid sequence as shown in any of SEQ ID NOs: 2, 4, 8, 10, 12, 14, 16, 18, 20, 30, 36, 39, 42, 44, 46, 48, 50, 52, 54, 56, 58 and 60;
  - 10 (b) an amino acid sequence encoded by a nucleic acid sequence as shown in any of SEQ ID NOs: 1, 3, 7, 9, 11, 13, 15, 17, 19, 29, 35, 38, 41, 43, 45, 47, 49, 51, 53, 55, 57 and 59;
  - (c) an amino acid sequence encoded by a nucleic acid sequence hybridizing with the complementary strand of a nucleic acid sequence as defined in (b)  
15 under stringent hybridization conditions;
  - (d) an amino acid sequence encoded by a nucleic acid sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (b) and (c).
- 20 The present invention also provides for a pharmaceutical composition comprising a nucleic acid sequence encoding a bispecific single chain antibody construct as defined above.
- Said nucleic acid molecule may be a natural nucleic acid molecule as well as a recombinant nucleic acid molecule. The nucleic acid molecule may, therefore, be  
25 of natural origin, synthetic or semi-synthetic. It may comprise DNA, RNA as well as PNA (peptide nucleic acid) and it may be a hybrid thereof.
- Thus, the present invention relates to a pharmaceutical composition comprising a nucleic acid molecule comprising a nucleotide sequence selected from the group consisting of:
- 30 (a) a nucleotide sequence encoding the mature form of a protein comprising the amino acid sequence of the bispecific single chain antibody constructs



defined herein, preferably as given in SEQ ID Nos: 2, 4, 8, 10, 12, 14, 16, 18, 20, 30, 36, 39, 42, 44, 46, 48, 50, 52, 54, 56, 58 and 60;

(b) a nucleotide sequence comprising or consisting of the DNA sequence as given in SEQ ID Nos: 1, 3, 7, 9, 11, 13, 15, 17, 19, 29, 35, 38, 41, 43, 45, 47, 49, 51, 53, 55, 57 and 59;

(c) a nucleotide sequence hybridizing with the complementary strand of a nucleotide sequence as defined in (b) under stringent hybridization conditions;

(d) a nucleotide sequence encoding a protein derived from the protein encoded by a nucleotide sequence of (a) or (b) by way of substitution, deletion and/or addition of one or several amino acids of the amino acid sequence encoded by the nucleotide sequence of (a) or (b);

(e) a nucleotide sequence encoding a protein having an amino acid sequence at least 60 % identical to the amino acid sequence encoded by the nucleotide sequence of (a) or (b);

(f) a nucleotide sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (a) to (e);

The term "mature form of the protein" defines in context with the present invention a protein translated from its corresponding mRNA and optional subsequently modified.

The term "hybridizing" has been defined in the context of the present invention herein above.

It is evident to the person skilled in the art that regulatory sequences may be added to the nucleic acid molecule comprised in the pharmaceutical composition of the invention. For example, promoters, transcriptional enhancers and/or sequences which allow for induced expression of the polynucleotide of the invention may be employed. A suitable inducible system is for example tetracycline-regulated gene expression as described, e.g., by Gossen and Bujard (Proc. Natl. Acad. Sci. USA 89 (1992), 5547-5551) and Gossen et al. (Trends Biotech. 12 (1994), 58-62), or a dexamethasone-inducible gene expression system as described, e.g. by Crook (1989) EMBO J. 8, 513-519.

Furthermore, it is envisaged for further purposes that nucleic acid molecules may contain, for example, thioester bonds and/or nucleotide analogues. Said modifications may be useful for the stabilization of the nucleic acid molecule against endo- and/or exonucleases in the cell. Said nucleic acid molecules may be transcribed by an appropriate vector containing a chimeric gene which allows for the transcription of said nucleic acid molecule in the cell. In this respect, it is also to be understood that such polynucleotide can be used for "gene targeting" or "gene therapeutic" approaches. In another embodiment said nucleic acid molecules are labeled. Methods for the detection of nucleic acids are well known in the art, e.g., Southern and Northern blotting, PCR or primer extension. This embodiment may be useful for screening methods for verifying successful introduction of the nucleic acid molecules described above during gene therapy approaches.

Said nucleic acid molecule(s) may be a recombinantly produced chimeric nucleic acid molecule comprising any of the aforementioned nucleic acid molecules either alone or in combination. Preferably, the nucleic acid molecule is part of a vector.

The present invention therefore also relates to a pharmaceutical composition comprising a vector comprising the nucleic acid molecule described in the present invention.

Many suitable vectors are known to those skilled in molecular biology, the choice of which would depend on the function desired and include plasmids, cosmids, viruses, bacteriophages and other vectors used conventionally in genetic engineering. Methods which are well known to those skilled in the art can be used to construct various plasmids and vectors; see, for example, the techniques described in Sambrook et al. (loc cit.) and Ausubel, Current Protocols in Molecular Biology, Green Publishing Associates and Wiley Interscience, N.Y. (1989), (1994). Alternatively, the polynucleotides and vectors of the invention can be reconstituted into liposomes for delivery to target cells. As discussed in further details below, a cloning vector was used to isolate individual sequences of DNA. Relevant sequences can be transferred into expression vectors where expression of a

particular polypeptide is required. Typical cloning vectors include pBluescript SK, pGEM, pUC9, pBR322 and pGBT9. Typical expression vectors include pTRE, pCAL-n-EK, pESP-1, pOP13CAT.

Preferably said vector comprises a nucleic acid sequence which is a regulatory  
5 sequence operably linked to said nucleic acid sequence encoding a bispecific single chain antibody constructs defined herein.

Such regulatory sequences (control elements) are known to the artisan and may include a promoter, a splice cassette, translation initiation codon, translation and insertion site for introducing an insert into the vector. Preferably, said nucleic acid  
10 molecule is operatively linked to said expression control sequences allowing expression in eukaryotic or prokaryotic cells.

It is envisaged that said vector is an expression vector comprising the nucleic acid molecule encoding a bispecific single chain antibody constructs defined herein.

The term "regulatory sequence" refers to DNA sequences which are necessary to  
15 effect the expression of coding sequences to which they are ligated. The nature of such control sequences differs depending upon the host organism. In prokaryotes, control sequences generally include promoters, ribosomal binding sites, and terminators. In eukaryotes generally control sequences include promoters, terminators and, in some instances, enhancers, transactivators or transcription  
20 factors. The term "control sequence" is intended to include, at a minimum, all components the presence of which are necessary for expression, and may also include additional advantageous components.

The term "operably linked" refers to a juxtaposition wherein the components so described are in a relationship permitting them to function in their intended manner.  
25 A control sequence "operably linked" to a coding sequence is ligated in such a way that expression of the coding sequence is achieved under conditions compatible with the control sequences. In case the control sequence is a promoter, it is obvious for a skilled person that double-stranded nucleic acid is preferably used.

Thus, the recited vector is preferably an expression vector. An "expression vector"  
30 is a construct that can be used to transform a selected host and provides for expression of a coding sequence in the selected host. Expression vectors can for

instance be cloning vectors, binary vectors or integrating vectors. Expression comprises transcription of the nucleic acid molecule preferably into a translatable mRNA. Regulatory elements ensuring expression in prokaryotes and/or eukaryotic cells are well known to those skilled in the art. In the case of eukaryotic cells they  
5 comprise normally promoters ensuring initiation of transcription and optionally poly-A signals ensuring termination of transcription and stabilization of the transcript. Possible regulatory elements permitting expression in prokaryotic host cells comprise, e.g., the  $P_L$ , *lac*, *trp* or *tac* promoter in *E. coli*, and examples of regulatory elements permitting expression in eukaryotic host cells are the AOX1 or  
10 *GAL1* promoter in yeast or the CMV-, SV40-, RSV-promoter (Rous sarcoma virus), CMV-enhancer, SV40-enhancer or a globin intron in mammalian and other animal cells.

Beside elements which are responsible for the initiation of transcription such regulatory elements may also comprise transcription termination signals, such as  
15 the SV40-poly-A site or the tk-poly-A site, downstream of the polynucleotide. Furthermore, depending on the expression system used leader sequences capable of directing the polypeptide to a cellular compartment or secreting it into the medium may be added to the coding sequence of the recited nucleic acid sequence and are well known in the art; see also, e.g., the appended examples.  
20 The leader sequence(s) is (are) assembled in appropriate phase with translation, initiation and termination sequences, and preferably, a leader sequence capable of directing secretion of translated protein, or a portion thereof, into the periplasmic space or extracellular medium. Optionally, the heterologous sequence can encode a fusion protein including an N-terminal identification peptide imparting desired  
25 characteristics, e.g., stabilization or simplified purification of expressed recombinant product; see supra. In this context, suitable expression vectors are known in the art such as Okayama-Berg cDNA expression vector pcDV1 (Pharmacia), pEF-Neo, pCDM8, pRc/CMV, pcDNA1, pcDNA3 (In-vitro-gene), pEF-DHFR and pEF-ADA, (Raum et al. Cancer Immunol Immunother (2001) 50(3), 141-  
30 150) or pSPORT1 (GIBCO BRL).

Preferably, the expression control sequences will be eukaryotic promoter systems



in vectors capable of transforming or transfecting eukaryotic host cells, but control sequences for prokaryotic hosts may also be used. Once the vector has been incorporated into the appropriate host, the host is maintained under conditions suitable for high level expression of the nucleotide sequences, and as desired, the collection and purification of the polypeptide of the invention may follow; see, e.g., the appended examples.

An alternative expression system which could be used to express a cell cycle interacting protein is an insect system. In one such system, *Autographa californica* nuclear polyhedrosis virus (AcNPV) is used as a vector to express foreign genes in *Spodoptera frugiperda* cells or in *Trichoplusia* larvae. The coding sequence of a recited nucleic acid molecule may be cloned into a nonessential region of the virus, such as the polyhedrin gene, and placed under control of the polyhedrin promoter. Successful insertion of said coding sequence will render the polyhedrin gene inactive and produce recombinant virus lacking coat protein coat. The recombinant viruses are then used to infect *S. frugiperda* cells or *Trichoplusia* larvae in which the protein of the invention is expressed (Smith, J. Virol. 46 (1983), 584; Engelhard, Proc. Nat. Acad. Sci. USA 91 (1994), 3224-3227).

Additional regulatory elements may include transcriptional as well as translational enhancers. Advantageously, the above-described vectors of the invention comprises a selectable and/or scorable marker.

Selectable marker genes useful for the selection of transformed cells and, e.g., plant tissue and plants are well known to those skilled in the art and comprise, for example, antimetabolite resistance as the basis of selection for dhfr, which confers resistance to methotrexate (Reiss, Plant Physiol. (Life Sci. Adv.) 13 (1994), 143-149); npt, which confers resistance to the aminoglycosides neomycin, kanamycin and paromycin (Herrera-Estrella, EMBO J. 2 (1983), 987-995) and hygromycin (Marsh, Gene 32 (1984), 481-485). Additional selectable genes have been described, namely trpB, which allows cells to utilize indole in place of tryptophan; hisD, which allows cells to utilize histinol in place of histidine (Hartman, Proc. Natl. Acad. Sci. USA 85 (1988), 8047); mannose-6-phosphate isomerase which allows cells to utilize mannose (WO 94/20627) and

ODC (ornithine decarboxylase) which confers resistance to the ornithine decarboxylase inhibitor, 2-(difluoromethyl)-DL-ornithine, DFMO (McConlogue, 1987, In: Current Communications in Molecular Biology, Cold Spring Harbor Laboratory ed.) or deaminase from *Aspergillus terreus* which confers resistance to

5 Blasticidin S (Tamura, Biosci. Biotechnol. Biochem. 59 (1995), 2336-2338).

Useful scorable markers are also known to those skilled in the art and are commercially available. Advantageously, said marker is a gene encoding luciferase (Giacomin, Pl. Sci. 116 (1996), 59-72; Scikantha, J. Bact. 178 (1996), 121), green fluorescent protein (Gerdes, FEBS Lett. 389 (1996), 44-47) or  $\beta$ -glucuronidase

10 (Jefferson, EMBO J. 6 (1987), 3901-3907). This embodiment is particularly useful for simple and rapid screening of cells, tissues and organisms containing a recited vector.

As described above, the recited nucleic acid molecule can be used alone or as part of a vector to express the encoded polypeptide in cells, for, e.g., gene therapy. The

15 nucleic acid molecules or vectors containing the DNA sequence(s) encoding any one of the above described bispecific single chain antibody constructs is introduced into the cells which in turn produce the polypeptide of interest. Gene therapy, which is based on introducing therapeutic genes into cells by ex-vivo or in-vivo techniques is one of the most important applications of gene transfer. Suitable

20 vectors, methods or gene-delivery systems for in-vitro or in-vivo gene therapy are described in the literature and are known to the person skilled in the art; see, e.g., Giordano, Nature Medicine 2 (1996), 534-539; Schaper, Circ. Res. 79 (1996), 911-919; Anderson, Science 256 (1992), 808-813; Verma, Nature 389 (1994), 239; Isner, Lancet 348 (1996), 370-374; Muhlhauser, Circ. Res. 77 (1995), 1077-1086;

25 Onodera, Blood 91 (1998), 30-36; Verma, Gene Ther. 5 (1998), 692-699; Nabel, Ann. N.Y. Acad. Sci. 811 (1997), 289-292; Verzeletti, Hum. Gene Ther. 9 (1998), 2243-51; Wang, Nature Medicine 2 (1996), 714-716; WO 94/29469; WO 97/00957, US 5,580,859; US 5,589,466; or Schaper, Current Opinion in Biotechnology 7 (1996), 635-640. The recited nucleic acid molecules and vectors may be designed

30 for direct introduction or for introduction via liposomes, or viral vectors (e.g., adenoviral, retroviral) into the cell. Preferably, said cell is a germ line cell,

embryonic cell, or egg cell or derived therefrom, most preferably said cell is a stem cell. An example for an embryonic stem cell can be, inter alia, a stem cell as described in, Nagy, Proc. Natl. Acad. Sci. USA 90 (1993), 8424-8428.

In accordance with the above, the present invention relates to methods to derive  
5 vectors, particularly plasmids, cosmids, viruses and bacteriophages used conventionally in genetic engineering that comprise a nucleic acid molecule encoding the polypeptide sequence of a bispecific single chain antibody constructs defined herein. Preferably, said vector is an expression vector and/or a gene transfer or targeting vector. Expression vectors derived from viruses such as  
10 retroviruses, vaccinia virus, adeno-associated virus, herpes viruses, or bovine papilloma virus, may be used for delivery of the recited polynucleotides or vector into targeted cell populations. Methods which are well known to those skilled in the art can be used to construct recombinant vectors; see, for example, the techniques described in Sambrook et al. (loc cit.), Ausubel (1989, loc cit.) or other standard  
15 text books. Alternatively, the recited nucleic acid molecules and vectors can be reconstituted into liposomes for delivery to target cells. The vectors containing the nucleic acid molecules of the invention can be transferred into the host cell by well-known methods, which vary depending on the type of cellular host. For example, calcium chloride transfection is commonly utilized for prokaryotic cells, whereas  
20 calcium phosphate treatment or electroporation may be used for other cellular hosts; see Sambrook, supra.

The recited vector may be the pEF-DHFR, pEF-ADA or pEF-neo.

The vectors pEF-DHFR and pEF-ADA have been described in the art, e.g. in Mack et al. (PNAS (1995) 92, 7021-7025) and Raum et al. (Cancer Immunol Immunother  
25 (2001) 50(3), 141-150).

It is further envisaged that the pharmaceutical composition of the invention comprises a host transformed or transfected with a vector defined herein above.

Said host may be produced by introducing said at least one of the above described  
30 vector or at least one of the above described nucleic acid molecules into the host. The presence of said at least one vector or at least one nucleic acid molecule in

the host may mediate the expression of a gene encoding the above described bespecific single chain antibody constructs.

The described nucleic acid molecule or vector which is introduced in the host may either integrate into the genome of the host or it may be maintained  
5 extrachromosomally.

The host can be any prokaryote or eukaryotic cell.

The term "prokaryote" is meant to include all bacteria which can be transformed or transfected with a DNA or RNA molecules for the expression of a protein of the invention. Prokaryotic hosts may include gram negative as well as gram positive  
10 bacteria such as, for example, *E. coli*, *S. typhimurium*, *Serratia marcescens* and *Bacillus subtilis*. The term "eukaryotic" is meant to include yeast, higher plant, insect and preferably mammalian cells. Depending upon the host employed in a recombinant production procedure, the protein encoded by the polynucleotide of the present invention may be glycosylated or may be non-glycosylated. Especially  
15 preferred is the use of a plasmid or a virus containing the coding sequence of the polypeptide of the invention and genetically fused thereto an N-terminal FLAG-tag and/or C-terminal His-tag. Preferably, the length of said FLAG-tag is about 4 to 8 amino acids, most preferably 8 amino acids. An above described polynucleotide can be used to transform or transfect the host using any of the techniques  
20 commonly known to those of ordinary skill in the art. Furthermore, methods for preparing fused, operably linked genes and expressing them in, e.g., mammalian cells and bacteria are well-known in the art (Sambrook, loc cit.).

Preferably, said the host is a bacteria, an insect, fungal, plant or animal cell.

It is particularly envisaged that the recited host may be a mammalian cell, more  
25 preferably a human cell or human cell line.

Particularly preferred host cells comprise CHO cells, COS cells, myeloma cell lines like SP2/0 or NS/0.

The pharmaceutical composition of the invention may also comprise a  
30 proteinaceous compound capable of providing an activation signal for immune effector cells useful for cell proliferation or cell stimulation.



The proteinaceous compound is not understood as an additional domain of the above defined bispecific single chain antibody construct, but at least one additional component of the pharmaceutical composition of the invention.

In the light of the present invention, said "proteinaceous compounds" providing an  
5 activation signal for immune effector cells" may be, e.g. a further activation signal for T cells (e.g. a further costimulatory molecule: molecules of the B7-family, Ox40 L, 4.1 BBL), or a further cytokine: interleukin (e.g. IL-2), or an NKG-2D engaging compound. Preferred formats of proteinaceous compounds comprise additional bispecific antibodies and fragments or derivatives thereof, e.g. bispecific scFv.  
10 Proteinaceous compounds can comprise, but are not limited to scFv fragments specific for the T cell receptor or superantigens. Superantigens directly bind to certain subfamilies of T cell receptor variable regions in an MHC-independent manner thus mediating the primary T cell activation signal. The proteinaceous compound may also provide an activation signal for immune effector cell which is a  
15 non-T cell. Examples for immune effector cells which are non-T cells comprise, inter alia, NK cells.

An additional technical feature of the pharmaceutical composition of the invention is that said pharmaceutical composition is thermostable at  $\geq 37^{\circ}\text{C}$ .

20

An alternative embodiment of the invention relates to a process for the production of a pharmaceutical composition of the invention, said process comprising culturing a host defined herein above under conditions allowing the expression of the construct and recovering the produced bispecific single chain antibody construct  
25 from the culture.

The transformed hosts can be grown in fermentors and cultured according to techniques known in the art to achieve optimal cell growth. The polypeptide of the invention can then be isolated from the growth medium, cellular lysates, or cellular membrane fractions. The isolation and purification of the, e.g., microbially  
30 expressed polypeptides of the invention may be by any conventional means such as, for example, preparative chromatographic separations and immunological

separations such as those involving the use of monoclonal or polyclonal antibodies directed, e.g., against a tag of the polypeptide of the invention or as described in the appended examples.

5 The conditions for the culturing of a host which allow the expression are known in the art and discussed herein above. The same holds true for procedures for the purification/recovery of said constructs.

10 A further alternative embodiment of the invention relates to the use of a bispecific single chain antibody construct as defined above, a nucleic acid sequence as defined above, a vector as defined above, a host as defined above and/or produced by a process as defined above for the preparation of a pharmaceutical composition for the prevention, treatment or amelioration of a tumorous disease.

In particular, the pharmaceutical composition of the present invention may be particularly useful in preventing, ameliorating and/or treating cancer.

15 Preferably said tumorous disease is epithelial cancer or a minimal residual cancer.

20 It is envisaged by the present invention that the above defined bispecific single chain antibody construct, nucleic acid molecules and vectors are administered either alone or in any combination using standard vectors and/or gene delivery systems, and optionally together with a pharmaceutically acceptable carrier or excipient. Subsequent to administration, said nucleic acid molecules or vectors may be stably integrated into the genome of the subject.

25 On the other hand, viral vectors may be used which are specific for certain cells or tissues and persist in said cells. Suitable pharmaceutical carriers and excipients are well known in the art. The pharmaceutical compositions prepared according to the invention can be used for the prevention or treatment or delaying the above identified diseases.

30 Furthermore, it is possible to use a pharmaceutical composition of the invention which comprises described nucleic acid molecules or vectors in gene therapy. Suitable gene delivery systems may include liposomes, receptor-mediated delivery systems, naked DNA, and viral vectors such as herpes viruses, retroviruses,

adenoviruses, and adeno-associated viruses, among others. Delivery of nucleic acids to a specific site in the body for gene therapy may also be accomplished using a biolistic delivery system, such as that described by Williams (Proc. Natl. Acad. Sci. USA 88 (1991), 2726-2729). Further methods for the delivery of nucleic acids comprise particle-mediated gene transfer as, e.g., described in Verma, Gene Ther. 15 (1998), 692-699.

Furthermore the invention relates to a method for the prevention, treatment or amelioration of a tumorous disease comprising the step of administering to a subject in the need thereof an effective amount a bispecific single chain antibody construct as defined above, a nucleic acid sequence as defined above, a vector as defined as defined above, a host as defined above and/or produced in by a process as defined above.

Preferably said subject is a human.

The method for the prevention, treatment or amelioration of the invention may comprise the co-administration of an above defined proteinaceous compound capable of an activation signal for immune effector cells to the subject. The co-administration may be a simultaneous co-administration or a non-simultaneous co-administration.

It is particularly preferred for the use and the method of the invention that said tumorous disease is epithelial cancer, preferably adenocarcinomas, or a minimal residual cancer, preferably early solid tumor, advanced solid tumor or metastatic solid tumor.

Finally, the present invention relates to a kit comprising a bispecific single chain antibody construct as defined above, a nucleic acid sequence as defined above, a vector as defined above and/or a host as defined above. It is also envisaged that the kit of this invention comprises a pharmaceutical composition as described herein above, either alone or in combination with further medicaments to be administered to a patient in need of medical treatment or intervention.

The Figures show:

**Figure 1:**

DNA and amino acid sequence of the anti-CD3-anti-EpCAM constructs **A)** anti-  
 5 CD3 VHVL stL x 3-1 VHVL (SEQ ID NO.:11,12), **B)** anti-CD3 VHVL aL x 4-7 VHVL  
 (SEQ ID NO.:1,2), **C)** anti-CD3 VHVL aL Ser x 4-7 VHVL (SEQ ID NO.:7, 8), **D)**  
 anti-CD3 VHVL stL x 4-7 VHVL (SEQ ID NO.:13,14), **E)** anti-CD3 VHVL stL x 4-7  
 VLVH (SEQ ID NO.:15,16), **F)** anti-CD3 VHVL aL x 5-10 VHVL (SEQ ID NO.:3,4),  
**G)** anti-CD3 VHVL aL Ser x 5-10 VHVL (SEQ ID NO.:9, 10), **H)** anti-CD3 VHVL stL  
 0 x 5-10 VHVL (SEQ ID NO.:17,18), **I)** anti-CD3 VHVL stL x 5-10 VLVH (SEQ ID  
 NO.:19,20), **J)** anti-CD3 VHVL aL x 3-1 VHVL (SEQ ID NO.:45, 46), **K)** anti-CD3  
 VHVL aL Ser x 3-1 VHVL (SEQ ID NO.:47,48), **L)** anti-CD3 VHVL aL x 3-5 VHVL  
 (SEQ ID NO.:49,50), **M)** anti-CD3 VHVL aL Ser x 3-5 VHVL (SEQ ID NO.:51,52),  
**N)** anti-CD3 VHVL stL x 3-5 VHVL (SEQ ID NO.:53,54), **O)** anti-CD3 VHVL aL x 4-  
 5 1 VHVL (SEQ ID NO.:55,56), **P)** anti-CD3 VHVL aL Ser x 4-1 VHVL (SEQ ID  
 NO.:57,58) and **Q)** anti-CD3 VHVL stL x 4-1 VHVL (SEQ ID NO.:59,60).

**Figure 2:**

FACS analysis of the constructs **A)** anti-CD3 VHVL stL x 5-10 VHVL (SEQ ID  
 10 NO.:18), **B)** anti-CD3 VHVL stL x 4-7 VHVL (SEQ ID NO.:14), **C)** anti-CD3 VHVL  
 aL x 5-10 VHVL (SEQ ID NO.:4), **D)** anti-CD3 VHVL aL x 4-7 VHVL (SEQ ID  
 NO.:2), **E)** anti-CD3 VHVL aL Ser x 5-10 VHVL (SEQ ID NO.:10), **F)** anti-CD3  
 VHVL aL Ser x 4-7 VHVL (SEQ ID NO.:8), **G)** anti-CD3 VHVL stL x 3-1 VHVL  
 (SEQ ID NO.:12), **H)** anti-CD3 VHVL stL x 5-10 VLVH (SEQ ID NO.:20) and **I)** anti-  
 15 CD3 VHVL stL x 4-7 VLVH (SEQ ID NO.:16) in CD3 positive Jurkat and EpCAM-  
 positive Kato III cells. A shift to the right shows binding. In Jurkat and KatoIII cells  
 the dotted line indicates the shift of the negative control (only secondary antibody),  
 dashed line shows the binding of an anti-EpCAM-anti-CD3 control antibody and the  
 bold line shows the bispecific construct of interest.

**Figure 3:**



DNA and amino acid sequence of the anti-EpCAM-anti-CD3 constructs A) 4-7 VLVHx anti-CD3 VHVL (SEQ ID NO.:41,42), B) 3-5 VLVHx anti-CD3 VHVL (SEQ ID NO.:29,30), C) 3-1 VLVHx anti-CD3 VHVL (SEQ ID NO.:35,36), D) 4-1 VLVHx anti-CD3 VHVL (SEQ ID NO.:38,39) and E) 5-10 VLVHx anti-CD3 VHVL (SEQ ID NO.:43,44).

**Figure 4:** FACS analysis of the constructs A) 4-7 VLVHx anti-CD3 VHVL (SEQ ID NO.:42), B) 3-5 VLVHx anti-CD3 VHVL (SEQ ID NO.:30), C) 3-1 VLVHx anti-CD3 VHVL (SEQ ID NO.:36), D) 4-1 VLVHx anti-CD3 VHVL (SEQ ID NO.:39) and E) 5-10 VLVHx anti-CD3 VHVL (SEQ ID NO.: 44) constructs in CD3 positive Jurkat and EpCAM-positive Kato III cells. A shift to the right shows binding.

**Figure 5:**

A representative elution pattern of an EpCAM bispecific antibody containing protein fractions from a Zn-Chelating Fractogel® column at 280 nm. High adsorption at 280 nm from 50-450 ml retention time was due to non-bound protein in the column flow through. The arrow at the peak at 530.09 ml indicates the EpCAM bispecific construct containing protein fraction that was used for further purification.

**Figure 6:**

A representative protein elution pattern from a Sephadex® S200 gel filtration column at 280 nm. The protein peak at 82.66 ml containing bispecific antibodies against CD3 and EpCAM corresponds to a molecular weight of ca. 52 kD. Fractions were collected from 40-140 ml retention time.

**Figure 7**

A) Cation exchange chromatogram of 3-1 x anti-CD3 (SEQ ID NO.:36) shows the overall charge isoforms of the protein. Cation exchange chromatography was performed on a MiniS® (Amersham) column. After washing with 20 mM MES buffer pH 5.5, the protein was eluted with a gradient of elution buffer containing 1 M NaCl: 0-30% in 60 column volumes. The bispecific construct was eluted at 23,58 ml. Unspecific protein was eluted with 1 M NaCl starting at 50 ml.

B) Cation exchange chromatogram of 5-10 x anti-CD3 (SEQ ID NO.:44) shows the overall charge isoforms of the protein. Cation exchange chromatography was performed as in Figure 7A. The bispecific construct was eluted at a shoulder at 35,77 ml. Unspecific protein was eluted with 1 M NaCl starting at 50 ml.

**Figure 8:**

A) Representative SDS-PAGE analysis of EpCAM bispecific single chain antibody protein fractions. Lane M: Molecular weight marker Lane 1: cell culture supernatant; lane 2: IMAC flow through; lane 3: IMAC wash; lane 4: IMAC eluate; lane 5: purified antibody against EpCAM and CD3 obtained from gel filtration.

B) Representative Western blot analysis of purified EpCAM bispecific single chain antibody protein fractions Lane 1: cell culture supernatant; lane 2: IMAC flow through; lane 3: IMAC wash; lane 4: IMAC eluate; lane 5: purified antibody against EpCAM and CD3 obtained from gel filtration.

**Figure 9:**

Cytotoxicity assay of C-terminal EpCAM binders anti-CD3x3-1 (SEQ ID NO.:46), anti-CD3 x-5-10 (SEQ ID NO.:4), and anti-CD3 x4-7 (SEQ ID NO.:2). CB15 T cell clone and CHO-EpCAM cells were used in an E:T ratio of 5:1. CHO-EpCAM cells were stained with PKH26 dye and the cells were counted after bispecific single chain antibody incubation with FACS analysis.

**Figure 10:**

Cytotoxicity assay of N-terminal EpCAM binders 3-1xanti-CD3 (SEQ ID NO.:36), and 5-10xanti-CD3 (SEQ ID NO.:44) . CB15 T cell clone and CHO-EpCAM cells were used in an E:T ration of 5:1. CHO-EpCAM cells were stained with PKH26 dye and the cells were counted after bispecific single chain antibody incubation with FACS analysis.

**Figure 11:**

- A) Sequence alignment of the CDR3 of the VH chains of EpCAM 3-1 (SEQ ID NO.:80), EpCAM 4-1 (SEQ ID NO.: 88), EpCAM 5-10 (SEQ ID NO.: 96), EpCAM 3-5 (SEQ ID NO.: 84), EpCAM 4-7 (SEQ ID NO.:92), compared with CDR3 of the VH chain of EpCAM M79, HD70 and 3B10. The NXD motif is depicted as bold.
- B) Comparison of the cytotoxic activity of 3-1xanti-CD3 (SEQ ID NO.: 36), 5-10xanti-CD3 (SEQ ID NO.:44), anti-CD3x4-7 (SEQ ID NO.:2) and anti-CD3x5-10 (SEQ ID NO.:18) with M79Xanti-CD3 and HD70xanti-CD3 controls. PBMC cells and Kato III cells were used in a E:T ratio of 10:1. KatoIII cells were stained with propidium iodide and the cells were counted after bispecific single chain antibody incubation with FACS analysis.

The invention will now be described by reference to the following biological examples which are merely illustrative and are not to be construed as a limitation of scope of the present invention.

**Example 1: Cloning and expression of the EpCAM constructs**

A number of constructs comprising anti-CD3 and anti-EpCAM in various structures and domain arrangements were generated. Anti-EpCAM VH and VL variable domains of the antibodies 3-1 are shown in SEQ ID NO.:79, 80, 81, 82, 3-5 in SEQ ID NO.:83, 84, 85, 86, 4-1 in SEQ ID NO.:87, 88, 89, 90, 4-7 SEQ ID NO.:91, 92, 93, 94 and 5-10 in SEQ ID NO.:95, 96, 97, 98. The constructs are summarized in Table 1.

Table 1. anti-CD3-anti-EpCAM and anti-EpCAM-anti-CD3 constructs

SEQ ID NO.: Construct No.	Construct	Domain arrangement	Distinctive feature
<b>anti-CD3xanti-EpCAM constructs</b>			
SEQ ID NO.: 1,2	anti-CD3x4-7	VH-VLXVH-VL	
SEQ ID NO.: 3, 4	anti-CD3x5-10	VH-VLXVH-VL	
SEQ ID NO.: 45,46	anti-CD3x3-1	VH-VLXVH-VL	
SEQ ID NO.: 49,50	anti-CD3x3-5	VH-VLXVH-VL	
SEQ ID NO.: 55,56	anti-CD3x4-1	VH-VLXVH-VL	
SEQ ID NO.: 7,8	anti-CD3x 4-7Cys-Ser	VH-VLXVH-VL	Cys-Ser mutation
SEQ ID NO.: 9,10	anti-CD3x 5-10Cys-Ser	VH-VLXVH-VL	Cys-Ser mutation
SEQ ID NO.: 47,48	anti-CD3x3-1	VH-VLXVH-VL	Cys-Ser mutation
SEQ ID NO.: 51,52	anti-CD3x3-5	VH-VLXVH-VL	Cys-Ser mutation
SEQ ID NO.: 57,58	anti-CD3x4-1	VH-VLXVH-VL	Cys-Ser mutation
SEQ ID NO.: 11,12	anti-CD3x3-1	VH-VLXVH-VL	(G <sub>4</sub> S) <sub>3</sub> -linker
SEQ ID NO.: 13,14	anti-CD3x4-7	VH-VLXVH-VL	(G <sub>4</sub> S) <sub>3</sub> -linker
SEQ ID NO.: 15,16	anti-CD3x4-7	VH-VLXVL-VH	(G <sub>4</sub> S) <sub>3</sub> -linker
SEQ ID NO.: 17,18 1	anti-CD3x5-10	VH-VLXVH-VL	(G <sub>4</sub> S) <sub>3</sub> -linker
SEQ ID NO.: 19,20	anti-CD3x5-10	VH-VLXVL-VH	(G <sub>4</sub> S) <sub>3</sub> -linker
SEQ ID NO.: 53,54	anti-CD3x3-5	VH-VLXVH-VL	(G <sub>4</sub> S) <sub>3</sub> -linker
SEQ ID NO.: 59, 60	anti-CD3x4-1	VH-VLXVH-VL	(G <sub>4</sub> S) <sub>3</sub> -linker
<b>anti-EpCAM- anti-CD3 constructs</b>			
SEQ ID NO.: 29,30	3-5xanti-CD3	VL-VHxVH-VL	
SEQ ID NO.: 35,36	3-1xanti-CD3	VL-VHxVH-VL	
SEQ ID NO.: 38,39	4-1xanti-CD3	VL-VHxVH-VL	
SEQ ID NO.: 41,42	4-7xanti-CD3	VL-VHxVH-VL	
SEQ ID NO.: 43,44	5-10xanti-CD3	VL-VHxVH-VL	



## 1.1 Cloning of C-terminal EpCAM-binders

### 1.1.1 Preparation of anti-CD3 PCR products

a) Anti-CD3 constructs with original 18 amino acid linker (SEQ ID NOs.:1, 2, 3 and 4)

5 The N-terminal original anti-CD3 containing the 18 amino acid linker (SEQ ID NO.:70) was obtained by PCR using the CD19xCD3 construct (Löffler A et al., Blood 2000 95:2098-103) as template and the following primers (CD3 VH *BsrGI*: AGGTGTACACTCCGATATCAAACCTGCAGCAG (SEQ ID NO.:5), CD3 VL *BspEI*: AATCCGGATTTCAGCTCCAGCTTGG (SEQ ID NO.:6)).

10 b) Anti-CD3 constructs with original 18 amino acid linker and Cys to Ser mutation in CDRH3 (SEQ ID Nos. 7,8, 9 and 10)

The N-terminal original anti-CD3 containing the 18 amino acid linker (Seq ID NO.:70) and the Cys to Ser mutation was obtained by PCR using a CD19xanti-CD3 (C→S mutation) construct as template and the primers CD3 VH *BsrGI* and  
15 CD3 VL *BspEI* (Seq ID Nos. 5 and 6). The CDRH3 sequence with the Cys-Ser mutation is shown in SEQ ID NO.:78.

c) Anti-CD3-anti-EpCAM constructs with (G<sub>4</sub>S)<sub>3</sub> linker (Seq ID Nos. 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20)

20 The N-terminal anti-CD3 containing the 15 amino acid standard (G<sub>4</sub>S)<sub>3</sub> linker (SEQ ID NO.:99) was obtained by PCR using the CD19xCD3 (Löffler A et al., Blood 2000 95:2098-103) as template. The anti-CD3 VH region and the anti-CD3 VL region were separately amplified by the following primers (CD3 VH: CD3 VH *BsrGI* AGGTGTACACTCCGATATCAAACCTGCAGCAG (SEQ ID NO.:5), 3'CD3 VH GS15 GGAGCCGCCGCCGCGCCAGAACCACCACCTGAGGAGACTGTGA  
25 GAGTGGTGCCTTG (SEQ ID NO.:21); CD3 VL: 5'CD3 VL GS15 GGCGGCGGCGGCTCCGGTGGTGGTGGTTCTGACATTCAGC TGACCCAGTCTCC (SEQ ID NO.:22), CD3 VL *BspEI* AATCCGGATTTCAGCTCCAGCTTGG (SEQ ID NO.:6)). Overlapping complementary sequences introduced into the PCR products were used to form the  
30 coding sequence of a 15-amino acid (G<sub>4</sub>S)<sub>3</sub> (single-letter amino acid code) (SEQ ID

NO.:99) linker during the subsequent fusion PCR. This amplification step was performed with the primer pair CD3 VH *BsrGI* (SEQ ID NO.:5) and CD3 VL *BspEI* (SEQ ID NO.:6).

**1.1.2 Cloning of the anti-CD3xanti EpCAM constructs in  $VH_{\text{anti-CD3}}-VL_{\text{anti-CD3}} \times VH_{\text{anti-EpCAM}}-VL_{\text{anti-EpCAM}}$  orientation (SEQ ID NO.:1,2, SEQ ID NO.:3,4, SEQ ID NO.:7,8, SEQ ID NO.:9,10, SEQ ID NO.:11,12, SEQ ID NO.:13,14 and SEQ ID NO.:17,18)**

The N-terminal original anti-CD3 containing the 18 amino acid linker (SEQ ID NO.:70) or the N-terminal original anti-CD3 containing the 15 amino acid standard (G<sub>4</sub>S)<sub>3</sub> linker (SEQ ID NO.:99) was cleaved with the restriction enzymes *BsrGI* and *BspEI* and subsequently cloned into the bluescript KS vector (Stratagene, La Jolla, CA), containing the amino acid sequence of an eukaryotic secretory signal (leader peptide) as a *EcoRI/BsrGI*-Fragment. After cleavage of this construct with *EcoRI* and *BspEI* the resulting DNA fragment comprising the respective anti-CD3 scFv with the leader peptide was cloned into a *EcoRI/BspEI* cleaved plasmid containing the c-terminal EpCAM binders 3-1 (SEQ ID NO.:79-82), 4-7 (SEQ ID NO.:91-94), or 5-10 (SEQ ID NO.:95-98) in pEFDHFR. pEFDHFR was described in Mack et al. Proc. Natl. Acad. Sci. USA 92 (1995) 7021-7025).

**1.1.3. Cloning of the anti-CD3xanti EpCAM constructs in  $VH_{\text{anti-CD3}}-VL_{\text{anti-CD3}} \times VL_{\text{anti-EpCAM}}-VH_{\text{anti-EpCAM}}$  orientation (SEQ ID Nos.: 15, 16, 19 and 20)**

The C-terminal anti-EpCAM antibody 4-7 (SEQ ID NO.:91-94) in VLVH orientation containing the 15 amino acid standard linker (SEQ ID NO.:99) was obtained by PCR. The 4-7 VH region and the 4-7 VL region were separately amplified by the following primers (4-7 VL: 4-7 VL *BspEI* FOR CTGAAATCCGGAGGTGGTGGATCCGAGCTCGTGATGACCCAGACTCC (SEQ ID NO.:100), 4-7 VL GS15 REV GGAGCCGCCGCCGCGCCAGAACCACCA CCACCTTTGATCTCAAGCTTGGTCCCC (SEQ ID NO.:101); 4-7 VH: 4-7 VH GS15 FOR GGCGGCGGCGGCTCCGGTGGTGGTGGTTCTGAGGTGCAGCTGCTCGAGCA G (SEQ ID NO.:23), 4-7 VH *SaI* REV TTTTAAGTCGACCTAATGATGATGAT-

GATGATGTGAGGAGACGGTGACCGTGG (SEQ ID NO.:24)). Overlapping complementary sequences introduced into the PCR products were used to form the coding sequence of a 15-amino acid (G<sub>4</sub>S)<sub>3</sub> (single-letter amino acid code) linker (SEQ ID NO.:99) during the subsequent fusion PCR. This amplification step was performed with the primer pair 4-7 VL *Bsp*El FOR and 4-7 VH *Sa*II REV (SEQ ID NO.100, SEQ ID NO.:24).

The C-terminal anti-EpCAM antibody 5-10 (SEQ ID NO.:95-98) in VLVH orientation containing the 15 amino acid standard linker (SEQ ID NO.:99) was obtained by PCR. The 5-10 VH region and the 5-10 VL region were separately amplified by the following primers (5-10 VL: 5-10 VL *Bsp*El FOR CTGAAATCCGGAGGTGGTGGATCCGAGCTCGTGATGACACAGTCTCCAT (SEQ ID NO.:25), 5-10 VL GS15 REV GGAGCCGCCGCCGCGCCAGAACCACCACCACCTTTGATCTCAAGCTTGGTCCCA G (SEQ ID NO.: 26); 5-10 VH: 5-10 VH GS15 FOR GGCGGCGGCGGCTCCGGTGGTGGTGGTTCTGAGGTGCAGCTGCTCGAGC (SEQ ID NO.:27), 5-10 VH *Sa*II REV TTTTAAGTCGACCTAATGATGATGATGATGTGAGGAGACGGTGACCGTGG (SEQ ID NO.:28)). Overlapping complementary sequences introduced into the PCR products were used to form the coding sequence of a 15-amino acid (G<sub>4</sub>S)<sub>3</sub> linker (SEQ ID NO.:99) during the subsequent fusion PCR. This amplification step was performed with the primer pair 5-10 VL *Bsp*El FOR and 5-10 VH *Sa*II REV (SEQ ID NO.:25, SEQ ID NO.:28).

These PCR products (5-10 VLVH and 4-7 VLVH) were cleaved with *Bsp*El and *Sa*II and ligated in the *Bsp*El/*Sa*II cleaved anti-CD3 VHVL stLx5-10 VHVL (SEQ ID NO.:17,18) or anti-CD3 VHVL stL x 4-7 (SEQ ID NO.:13, 14) VHVL in pEFDHFR replacing the 5-10 VHVL DNA fragment.

#### 1.1.4. Expression and binding of the anti-CD3-EpCAM constructs

After confirmation of the sequence coding for the bispecific single chain by sequencing the plasmid was transfected into DHFR deficient CHO cells for eukaryotic expression. Eukaryotic protein expression in DHFR deficient CHO cells

was performed as described in Kaufmann R.J. (1990) Methods Enzymol. 185, 537-566). The transfected cells were then expanded and 1 litre of supernatant produced. Expression and binding of the bispecific single chain molecules were confirmed by FACS analyses. For that purpose the EpCAM positive human gastric cancer cell line Kato III (obtained from American Type Culture Collection (ATCC) Manassas, VA 20108 USA, ATCC number: HTB-103) was used. Binding of the anti-CD3 part was demonstrated on Jurkat cells (ATCC TIB 152).

Cells were cultured according to the recommendations of the supplier and ca. 200000 cells were incubated with 10µg/ml of the construct in 50µl PBS with 2%FCS. The binding of the construct was detected with an anti-His antibody (Penta-His Antibody, BSA free, obtained from Quiagen GmbH, Hilden, FRG) at 2µg/ml in 50µl PBS with 2%FCS. As a second step reagent a R-Phycoerythrin-conjugated affinity purified F(ab')<sub>2</sub> fragment, goat anti-mouse IgG, Fc-gamma fragment specific antibody, diluted 1:100 in 50µl PBS with 2% FCS (obtained from Dianova, Hamburg, FRG) was used. The samples were measured on a FACSscan (BD biosciences, Heidelberg, FRG). All the constructs comprising anti-CD3 and anti-EpCAM showed stronger binding affinity to CD3 and to EpCAM than the prior art anti-EpCAM (M79)xanti-CD3 bispecific antibody (Figure 2).

## 1.2 N-terminal EpCAM binders

### 1.2.1 Cloning of the anti-EpCAMxanti-CD3 constructs

#### Cloning of the construct 3-5xanti-CD3 (SEQ ID NOs.29, 30):

The C-terminal 3-5 in VH-VL orientation was obtained by PCR for the construction of 3-5 xanti-CD3 (SEQ ID NO.:29) molecule. Fragments I and II were amplified by PCR using primer pairs me 81 (SEQ ID NO.:31) /me 90 (SEQ ID NO.:34) and me 83 (SEQ ID NO.:32) /me 84 (SEQ ID NO.:33), respectively. Hot Start PCR was done using the Expand High Fidelity System of Roche Diagnostics. 20 cycles (94°C/30 sec; 60°C/1min;72°C/1min) were used for amplification followed by one cycle of 3 min at 72°C.

PCR fragments I and II were subjected to electrophoresis on a 1.5% agarose gel. Fragments were mixed (1 ng of each) and used as a template for the next PCR



reaction performed with primer pair me 81 (SEQ ID NO.:31) and me 84 (SEQ ID NO.:33) for amplification of fragment III. PCR was performed as described above. Fragment III was purified on an agarose gel and digested with BssHII and BspEI (Biolabs), purified and subsequently cloned into the corresponding sites of the pEF-dHFR-signal peptide (77/78)- anti-CD3 cloning vector, which facilitates cloning of anti-target variable regions in front of the anti-CD3 region. The vector has a unique BssHII site just after the signal peptide followed by BspEI site, linker (G<sub>4</sub>S) and anti-CD3 region. The cloned region was verified by restriction digests and by DNA-sequencing.

10 Sequences of the Primers used:

Me 81: 5'- GGA TGC GCG CGA GCT CGT GAT GAC CCA GAC TCCA CTC TCC -3' (SEQ ID NO.:31)

Me 83: 5'- GGT TCT GGC GGC GGC GGC TCC GGT GGT GGT GGT TCT GAG GTG CAG CTG CTC GA CAG TCT G -3' (SEQ ID NO.:32)

15 Me 84: 5'- GTG CTC CGG AGG AGA CGG TGA CCG TGG TCC CTT GGC CCC AG -3' (SEQ ID NO.:33)

Me 90: 5'- CCG GAG CCG CCG CCG CCA GAA CCA CCA CCA CCT TTG ATC TCA AGC TTG GTC CC -3' (SEQ ID NO.:34)

Cloning of the construct 3-1xanti-CD3 (SEQ ID NO.:35, 36):

20 The C-terminal 3-1 in VH-VL orientation was obtained by PCR for the construction of 3-1 xanti-CD3 (SEQ ID NO.:35) molecule. Fragments I and II were amplified by PCR using primer pairs me 91a (SEQ ID NO.:37) /me 90 (SEQ ID NO.:34) and me 83 (SEQ ID NO.:32) /me 84 (SEQ ID NO.:33) , respectively. PCR was performed as above.

25 Agarose gel fragments comprising PCR fragments I and II were used as a template for the next PCR reaction performed with primer pair me 91a (SEQ ID NO.:37) and me 84 (SEQ ID NO.:33) for amplification of fragment III. PCR was performed as described above except, annealing was performed at 68°C instead of at 60°C. Fragment III was purified on an agarose gel and digested with BsrGI and BspEI

(Biolabs), purified and subsequently cloned into the corresponding sites of the pEF-dHFR-M79 X anti-CD3 cloning vector. The cloned region was verified by restriction digests and by DNA-sequencing.

Me 91a: 5'- GGA TTG TAC A CTCC GA GCT CGT CAT GAC CCA GTC TCC ATC  
5 TTA TCT TGC TGC -3' (SEQ ID NO.:37)

Cloning of the construct 4-1xanti-CD3 (SEQ ID NO.:38, 39) :

The C-terminal 4-1 in VH-VL orientation was obtained by PCR for the construction of 4-1 xanti-CD3 (SEQ ID NO.:38, 39) molecule. Fragments I and II were amplified by PCR using primer pairs me 92a (SEQ ID NO.:40) /me 90 (SEQ ID NO.:34) and  
10 me 83 (SEQ ID NO.:32) /me 84 (SEQ ID NO.:33), respectively. PCR was performed as above in annealing temperature of 60°C.

Agarose gel fragments comprising PCR fragments I and II were used as a template for the next PCR reaction performed with primer pair me 92a (SEQ ID NO.:40) and me 84 (SEQ ID NO.:33) for amplification of fragment III. PCR was performed as  
15 described above except, annealing was performed at 68°C instead of at 60°C. Fragment III was purified on an agarose gel and digested with BsrGI and BspEI (Biolabs), purified and subsequently cloned into the corresponding sites of the pEF-dHFR-M79 X anti-CD3 is cloning vector. The cloned region was verified by restriction digests and by DNA-sequencing.

20 Me 92a: 5'- GGA TTG TAC A CTCC GA GCT CGT GAT GAC ACA GTCTCC ATC CTC C -3' (SEQ ID NO.:40)

Cloning of the construct 4-7xanti-CD3 (SEQ ID NO.:41,42)

The C-terminal 4-7 in VH-VL orientation was obtained by PCR for the construction of 4-7 xanti-CD3 (SEQ ID NO.:41, 42) molecule. Fragments I and II were amplified  
25 by PCR using primer pairs me 81 (SEQ ID NO.:31) /me 90 (SEQ ID NO.:34) and me 83 (SEQ ID NO.:32) /me 84 SEQ ID NO.:33), respectively. PCR was performed as above with an annealing temperature of 60°C.

Agarose gel fragments comprising PCR fragments I and II were used as a template for the next PCR reaction performed with primer pair me 81 (SEQ ID NO.:31) and

me 84 (SEQ ID NO.:33) for amplification of fragment III. PCR was performed as described above. Fragment III was purified on an agarose gel and digested with BssHII and BspEI (Biolabs), purified and subsequently cloned into the corresponding sites of the pEF-dhfr-signal peptide (77/78)- anti-CD3 cloning  
5 vector. The cloned region was verified by restriction digests and by DNA-sequencing.

Cloning of the construct 5-10xanti-CD3 (SEQ ID NO.:43, 44) :

The C-terminal 5-10 in VH-VL orientation was obtained by PCR for the construction of 5-10xanti-CD3 (SEQ ID NO.:43, 44) molecule. Fragments I and II were amplified  
10 by PCR using primer pairs me 92a (SEQ ID NO.:40) /me 90 (SEQ ID NO.:34) and me 83 (SEQ ID NO.:32) /me 84 (SEQ ID NO.:33), respectively. PCR was performed as above with an annealing temperature of 60°C.

Agarose gel fragments comprising PCR fragments I and II were used as a template for PCR with primer pair me 92a (SEQ ID NO.:40) and me 84 (SEQ ID NO.:33) for  
15 amplification of fragment III. PCR was performed as described above except, annealing was performed at 68°C instead of at 60°C. Fragment III was purified on an agarose gel and digested with BsrGI and BspEI (Biolabs), purified and subsequently cloned into the corresponding sites of the pEF-dhfr-M79 X anti-CD3 cloning vector. The cloned region was verified by restriction digests and by DNA-  
20 sequencing.

**1.2.2 Expression of anti-EpCAMxanti-CD3 bispecific molecules**

CHO-cells lacking DHFR gene were maintained in alpha MEM medium (Life Technologies, cat.no: 32561) supplemented with 10% fetal Calf Serum (Life Technologies, heat inactivated at 65°C for 30 minutes) and with HT (Hypoxanthin  
25 and Thymidine; Life Technologies, cat. no: 41065-012). The cells were transfected with pEF-dHFR-3-1xanti-CD3 (SEQ ID NO.:35, 36), pEF-dHFR-3-5xanti-CD3 (SEQ ID NO.:29, 30), pEF-dHFR-4-1xanti-CD3 (SEQ ID NO.:38, 39), pEF-dHFR-4-7xanti-CD3 (SEQ ID NO.:41, 42) and pEF-dHFR-5-10xanti-CD3 (SEQ ID NO.:43, 44) using Lipofectamine 2000 kit (Invitrogen; cat. no:11668-019) according to the  
30 instructions provided by the Manufacturer. After 48 hrs, the cells were subjected to

selection by transferring the transfected cells into the selection medium (alpha MEM medium (cat. no:32561) containing heat inactivated 10% dialysed fetal Calf Serum (Life Technologies). After 2-3 weeks of selection, the cells were grown for 8 to 9 days (in 500 ml of selection medium) for production of bispecific molecules in 2  
5 litre Tissue culture Roller Bottles (Falcon (cat. no: 353068;Becton Dickinson Labware). The tissue culture medium was centrifuged at 4°C for 10 minutes at 300g (1300rpm) to remove the cells and cell debris. The supernatant containing the secreted bispecific molecules was stored at -20°C until further analysis.

### 1.2.3 Binding assays of bispecific anti EpCAMxanti CD3 variants

10 In order to analyze the binding strength of the bispecific anti-EpCAMxanti-CD3 single chain constructs of the invention, the following binding assay was carried out.

250000 Jurkat cells (for CD3 binding) and Kato cells (for EpCAM binding) were independently incubated with crude supernatants (50µl) containing bispecific  
15 construct for 45 min. at 4°C. Thereafter, the cells were washed twice in FACS buffer (phosphate-buffered saline containing 1% fetal calf serum (FCS) and 0.05% sodium azide) and incubated with mouse anti-His antibody (Dianova,DIA910) for 60 min. at 4°C. Washing steps were performed as above.

The cells were finally incubated either with goat anti-mouse-FITC-conjugated  
20 antibody (BD 550003) or with anti-mouse-PE conjugated antibody (IgG) (Sigma, P8547). After washing steps, 10,000 events were analysed using FACS Calibur (B&D). All the EpCAM constructs showed strong binding (Figure 4).

### Example 2. Purification of the EpCAM constructs

25 In order to purify the bispecific single chain constructs comprising anti-EpCAM and anti-CD3 the CHO-EpCAM cells were grown in roller bottles with HiClone® CHO modified DMEM medium (HiQ) for 7 days before harvest. The cells were removed by centrifugation and the supernatant containing the expressed protein was stored at -20°C.



Äkta FPLC System® (Pharmacia) and Unicorn Software® were used for chromatography. All chemicals were of research grade and purchased from Sigma (Deisenhofen) or Merck (Darmstadt).

IMAC was performed, using a Fractogel® column (Pharmacia) that was loaded with  $\text{ZnCl}_2$  according to the manufacturers protocol. The column was equilibrated with buffer A2 (20 mM NaPP pH 7.5, 0.4 M NaCl) and the cell culture supernatant (500ml) was applied to the column (10 ml) with a flow rate of 3 ml/min. The column was washed with buffer A2 to remove unbound sample. Bound protein was eluted using a 2-step gradient of buffer B2 (20 mM NaPP pH 7.5, 0.4 M NaCl, 0.5 M Imidazol). In Step 1 20% buffer B2 in 10 column volumes was used and in Step2 100% buffer B2 in 10 column volumes was used. Eluted protein fractions from the 100% step were pooled for further purification.

Gel filtration chromatography was performed on a Sephadex S200 HiPrep® column (Pharmacia) equilibrated with PBS (Gibco). Eluted protein samples (flow rate 1ml/min) were subjected to SDS-Page and Western Blot for detection.

The column was previously calibrated for molecular weight determination (molecular weight marker kit, Sigma MW GF-200).

Protein concentrations were determined using protein assay dye (MicroBCA, Pierce) and IgG (Biorad) as standard protein. The yields of the protein are shown in Table 2. All constructs were producible.

**Table 2. Yields of the single-chain bispecific constructs comprising anti-EpCAM and anti-CD3**

Construct	Yield [µg purified protein per liter culture]
4-1 x anti-CD3 (SEQ ID NO.:39)	172.5
3-5 x anti-CD3 (SEQ ID NO.:30)	265
4-7 x anti-CD3 (SEQ ID NO.:42)	37
anti-CD3 x 4-7. (SEQ ID NO.:2)	112.5
anti-CD3 Cys-Ser x 4-7 (SEQ ID NO.:8)	140
3-1 x anti-CD3 (SEQ ID NO.:36)	265
5-10 x anti-CD3 (SEQ ID NO.:44)	400
anti-CD3 x 5-10 (SEQ ID NO.:4)	195

A further high resolution cation exchange chromatography was performed on a MiniS® column (Amersham), equilibrated with 20mM MES buffer pH 5.5. The sample was diluted 1:3 with the same buffer before loading to the column. Bound protein was eluted with a gradient of equilibration buffer containing 1M NaCl: 0-30% in 60 column volumes. Remaining protein was eluted in 3 column volumes of 1M NaCl (**Figure 7**).

The EpCAM bispecific single chain construct proteins were isolated in a two-step purification process including immobilized metal affinity chromatography (IMAC) (**Figure 5**) and gel filtration (**Figure 6**). The main product had a molecular weight of 52 kDa under native conditions as determined by gelfiltration in PBS.

Purified bispecific protein was analyzed in SDS PAGE under reducing conditions performed with precast 4-12% Bis Tris gels (Invitrogen). Sample preparation and application were according to the manufacturers protocol. The molecular weight was determined with MultiMark® protein standard (Invitrogen). The gel was stained with colloidal Coomassie (Invitrogen protocol). The purity of the isolated protein was shown to be >95% (**Figure 8A**). Western Blot was performed with an Optitran BA-S83® membrane and the Invitrogen Blot Module according to the manufacturers protocol. The antibodies used were Penta His (Qiagen) and Goat-anti-Mouse-Ig labeled with alkaline phosphatase (AP) (Sigma), the chromogenic

substrate solution was BCIP/NBT liquid (Sigma). The EpCAM bispecific protein could be specifically detected by Western Blot (Figure 8B). The main signal corresponds to the main band in the SDS PAGE at 52 kD corresponding to the purified bispecific molecule.

5

### **Example 3. Cytotoxicity assays of the constructs comprising anti-CD3 and anti-EpCAM**

In order to test the bioactivity of the constructs comprising anti-EpCAM and anti-CD3 a FACS based cytotoxicity test was performed.

- 10 For the cytotoxicity test, CHO cells from the American Type Cell Culture Collection (ATCC, Manassas, USA) were transfected with epithelial cell adhesion molecule (EpCAM). A cell clone derived from this transfection, referred to as CHO-EpCAM cells, was used for the experiments. CHO-EpCAM ( $1.5 \times 10^7$ ) cells were washed free of serum two times with PBS and incubated with PKH26 dye (Sigma-Aldrich
- 15 Co.) according to the manufacturers instructions. After staining cells were washed two times with RPMI/10% FCS.

Cells were counted and mixed with CB15 effector cells. The CD4-positive T cell clone CB15 was provided by Dr. Fickenscher, University of Erlangen/Nuernberg, Germany. Cells were cultured as recommended by the suppliers. The resulting cell

20 suspension contained 400.000 target and  $2 \times 10^6$  effector cells per ml. 50  $\mu$ l of the mixture was used per well in a 96 well round bottom plate.

Antibodies were diluted in RPMI/10% FCS to the required concentration and 50  $\mu$ l of this solution was added to the cell suspension. A standard reaction was incubated for 16 h at 37°C / 5% CO<sub>2</sub>. Propidium iodide was added to a final

25 concentration of 1  $\mu$ g/ml. After 10 min of incubation at room temperature cells were analysed by FACS. PKH26 fluorescence was used for positive identification of target cells. Cytotoxicity was measured as ratio of PI positive over all target cells. Sigmoidal dose response curves typically had  $R^2$  values  $>0.97$  as determined by Prism Software (GraphPad Software Inc., San Diego, USA) (Figure 9 and 10).

EC<sub>50</sub> values calculated by the analysis program were used for comparison of bioactivity. All the constructs of the invention show at least 50 times better cytotoxicity (maximum EC<sub>50</sub>-value 169 pg/ml) than the prior art construct M79xanti-CD3 (8628 pg/ml).

5

**Example 4. Determination of the binding affinity by BIAcore™ 2000 of the constructs comprising anti-EpCAM and anti-CD3 to EpCAM**

In order to show the superior binding affinity of the constructs of the invention, the KD values of the constructs and of the prior art anti-EpCAM construct (M79)xanti-CD3 were determined.

Kinetic binding experiments were performed using surface plasmon resonance on the BIAcore™ 2000, Biacore AB (Uppsala, Sweden) with a flow rate of 5 µL/min and HBS-EP (0.01 M HEPES, pH 7.4, 0.15 M NaCl, 3 mM EDTA, 0.005% surfactant P20) as running buffer at 25 °C. The extracellular domain of the EpCAM antigen (residues 17-265) was immobilized onto flow cells 2-4 on a CM5 sensor chip. The chip surface was activated injecting 80 µL of 0.1 M sodium-hydroxysuccinimid, 0.4 M N-ethyl-N'(3—dimethylaminepropyl)-carbodiimid (NHS/EDC). The antigen was coupled by manual injection of 60 µg/mL EpCAM in 0.01 M sodium-acetate, pH 4.7. Different densities of antigen were immobilized on flow cells 2-4 adjusting the amount of manual injection times. Flow cell 1 was left empty while flow cell 2 was coated with the highest density of EpCAM (4100 RU). Flow cell 3 was coated with ¼ of the amount of antigen immobilized on flow cell 2 (974 RU) and flow cell 4 was coated with lowest density of Ep-CAM antigen (265 RU). The activated surface of the sensor chip was blocked injecting 85 µL of 1 M ethanolamine and the chip was left to equilibrate over night at a constant flow of 5 µL/min of HBS-EP.

Binding kinetics of the bispecific constructs were measured injecting 10 µL of protein solution at concentrations ranging from 4 µM-0.07 µM and monitoring the dissociation for 100 sec. Protein was buffered in HBS-EP. The data were fitted using BIAevaluation™ software determining the rate constant for dissociation and



association kinetics with a 1:1 Langmuir binding equation (1, 2). Where A is the concentration of injected analyte and B[0] is Rmax.

$$dB/dt = -(ka * [A] * [B] - kd * [AB]) \quad (1)$$

$$dAB/dt = -(ka * [A] * [B] - kd * [AB]) \quad (2)$$

- 5 Kinetic binding curves were determined in four concentrations of each bispecific construct analysed. The independent fitting of the raw data resulted in dissociation and association rate constants that were used to calculate the equilibrium dissociation constant (KD). The calculated KD values were unbiased for concentration indicating reliable data analysis. The average of the independently  
10 determined dissociation constants as well as the standard deviation are summarized in table 3.

The analysed bispecific constructs bind to the Ep-CAM antigen immobilized on the chip surface within a well defined affinity range. The standard deviation for the calculated average dissociation constant is as expected.

15

**Table 3: Dissociation constants for the bispecific constructs binding to EpCAM.**

	KD (M)
M79 x anti-CD3 (control)	4,0x10 <sup>-6</sup>
4-1 x anti-CD3 (SEQ ID NO.:39)	2,5x10 <sup>-7</sup>
3-5 x anti-CD3 (SEQ ID NO.:30)	2,3 x10 <sup>-7</sup>

- The prior art anti-EpCAM x anti-CD3 construct M79xCD3 had a KD of 4,0x10<sup>-6</sup> M  
20 while surprisingly the constructs of the invention have a KD in the range of 2,3 x10<sup>-7</sup> -2,5 x10<sup>-7</sup> M. Thus, the constructs of the invention have more than 15 times stronger binding affinity than the prior art construct.

**Example 5. Comparison of the cytotoxic activity of the constructs of the invention with prior art constructs**

In order to compare the bioactivity of constructs having the NXD motif with  
5 conventional M79xCD3 and HD70xCD3 constructs the following cytotoxic assay  
was carried out.

Katolli cells (ATCC HTB-103) were used as target cells and grown in RPMI  
supplemented with 10% fetal calf serum at 37°C in a 5% CO<sub>2</sub> humidified incubator.  
Subconfluent cultures were treated with 0.25% trypsin, counted in a Neubauer  
10 chamber slide and checked for vitality by trypan-blue exclusion. Only cultures with  
>95% vitality were used for cytotoxicity assays. Target cells were stained with  
PKH26 fluorescent membrane dye according to the manufacturers manual (Sigma-  
Aldrich GmbH, Germany, PKH26-GL). Cell number was adjusted to  $8 \times 10^5$  cells/ml  
in RPMI complete medium.

15 Human peripheral blood mononuclear cells (PBMCs) were used as effector cells  
and isolated from healthy donors using ficoll density gradient centrifugation with  
subsequent 100 x g centrifugation to remove thrombocytes. The pellet was  
resuspended in 10 vol. erythrocyte lysing buffer and incubated at room  
20 temperature for 10 min. Lysing reaction was stopped by addition PBS. PBMCs  
were resuspended in RPMI 1640 complete medium and cell number adjusted to  
 $8 \times 10^6$  cells/ml.

25 Equal volumes of target and effector cell suspension were mixed and 50 µl of this  
suspension transferred to each well of a 96 well round bottom plate, 50 µl of  
EpCAM bispecific antibody serial dilution or RPMI complete medium as a negative  
control was added. Plates were incubated for 16 to 20 hrs at 37°C, 5% CO<sub>2</sub> in a  
humidified incubator. 50 µl propidium iodide was added to a final concentration of 1  
µg/ml and incubated 15 min at room temperature. Samples were analysed by flow  
30 cytometry (FACSCalibur, Becton Dickinson).  $2 \times 10^4$  events were counted.

Target cells were identified by their PKH26 fluorescent label and cytotoxicity within this population was subsequently determined. Viable cells were separated from dead cells by propidium iodide staining and the percentage of dead target cells was used as a measure for cytotoxicity. Mean values were plotted against the concentration of the bispecific antibody on a logarithmic scale, resulting in a dose response curve (Figure 11B). The corresponding EC<sub>50</sub> values were obtained after nonlinear fitting of data with the GraphPad Prism software.

The cytotoxic activity of constructs having the NXD motif (SEQ ID NO.:36, 44, 2 and 18) was compared with conventional constructs M79xanti-CD3 and HD70-xanti-CD3 (Fig. 11B). A sequence alignment of the CDR3 regions of the VH chains of 3-1, 5-10, 4-7, 3-5 and 4-1 with M79, HD70 and 3B10 is shown in Figure 11A. Only 3-1, 5-10, 4-7, 3-5 and 4-1 have the NXD motif and furthermore, the lengths of the CDR3 regions differ. As can be seen from Figure 11A, 3-1, 4-1 and 5-10 have a CDR-H3 region of 10 amino acids, 3-5 and 4-7 have 14 amino acids whereas the prior art M79 has 8 amino acids, 3B10 has 6 amino acids and HD70 has 18 amino acids.

SEQ ID NO.: 36, 44, 2 and 18 showed a clearly better bioactivity compared to the conventional M79 and HD70 constructs (2250 pg/ml and less compared to 71460 and 11327 pg/ml of the prior art constructs, respectively) demonstrating the advantageous effects of the constructs of the invention.

## Claims

1. A pharmaceutical composition comprising a bispecific single chain antibody construct, whereby said construct comprises or consists of at least two domains, whereby one of said domains binds to human EpCAM antigen and a second domain binds to human CD3 antigen, wherein said binding domain specific for EpCAM comprises at least one CDR-H3 region comprising the amino acid sequence NXD preferably in position 102 to 104 of SEQ ID NOs: 80, 88 and 96, or preferably in position 106 to 108 of SEQ ID NOs: 84 and 92, wherein X is an aromatic amino acid.
2. The pharmaceutical composition of claim 1, wherein X is W or Y.
3. The pharmaceutical composition of claim 1 or 2, wherein the CDR-H3 comprises at least 9 amino acid residues.
4. The pharmaceutical composition of any of claims 1 to 3, wherein said binding domain specific for EpCAM has a  $K_D$  value of more than  $5 \times 10^{-9}$  M.
5. The pharmaceutical composition of any of claims 1 to 4, wherein said binding domain specific for EpCAM has a  $K_D$  value in a range between  $1 \times 10^{-7}$  and  $5 \times 10^{-9}$  M and said binding domain specific for CD3 has a  $K_D$ -value in a range between  $1 \times 10^{-6}$  and  $5 \times 10^{-9}$  M.
6. A pharmaceutical composition comprising a bispecific single chain antibody construct, whereby said construct comprises or consists of at least two domains, whereby one of said at least two domains specifically binds to human EpCAM antigen and a second domain binds to human CD3 antigen, wherein said binding domain specific for EpCAM comprises at least one CDR-H3 region of at least 9 amino acid residues and wherein said binding



domain specific for EpCAM has a  $K_D$  value of more than  $5 \times 10^{-9}$  M.

7. The pharmaceutical composition of any of claims 1 to 6, wherein said binding domain specific for CD3 has a  $K_D$  value of more than  $10^{-7}$  M.

5

8. The pharmaceutical composition of any of claims 1 to 7, wherein the CDR-H3 region comprises at least 14 amino acids.

9. The pharmaceutical composition of any of claims 1 to 8, wherein the  $V_H$  chain domains specific for human EpCAM antigen is selected from the group consisting of:

10

(a) an amino acid sequence as shown in any of SEQ ID NO: 80, SEQ ID NO: 84, SEQ ID NO: 88, SEQ ID NO: 92 and SEQ ID NO: 96;

15

(b) an amino acid sequence encoded by a nucleic acid sequence as shown in SEQ ID NO: 79, SEQ ID NO: 83, SEQ ID NO: 87, SEQ ID NO: 91 and SEQ ID NO: 95;

(c) an amino acid sequence encoded by a nucleic acid sequence hybridizing with the complementary strand of a nucleic acid sequence as defined in (b) under stringent hybridization conditions;

20

(d) an amino acid sequence encoded by a nucleic acid sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (b) and (c).

10. The pharmaceutical composition of any of claims 1 to 9, wherein the  $V_L$  chain domains specific for human EpCAM antigen is selected from the group consisting of:

25

(a) an amino acid sequence as shown in any of SEQ ID NO: 82, SEQ ID NO: 86, SEQ ID NO: 90, SEQ ID NO: 94 and SEQ ID NO: 98;

30

(b) an amino acid sequence encoded by a nucleic acid sequence as shown in SEQ ID NO: 81, SEQ ID NO: 85, SEQ ID NO: 89, SEQ ID NO: 93 and SEQ ID NO: 97;

(c) an amino acid sequence encoded by a nucleic acid sequence

hybridizing with the complementary strand of a nucleic acid sequence as defined in (b) under stringent hybridization conditions;

- (d) an amino acid sequence encoded by a nucleic acid sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (b) and (c).

11. The pharmaceutical composition of any of claims 1 to 10, wherein the binding domains specific for the CD3 antigen is derived from an antibody selected from the group consisting of: X35-3, VIT3, BMA030 (BW264/56), CLB-T3/3, CRIS7, YTH12.5, F111-409, CLB-T3.4.2, TR-66, WT32, SPv-T3b, 11D8, XIII-141, XIII-46, XIII-87, 12F6, T3/RW2-8C8, T3/RW2-4B6, OKT3D, M-T301, SMC2, WT31 and F101.01.

12. The pharmaceutical composition of any of claims 1 to 11, wherein said bispecific single chain antibody construct comprises an amino acid sequence selected from the group of

- (a) an amino acid sequence as shown in any of SEQ ID NOs: 2, 4, 8, 10, 12, 14, 16, 18, 20, 30, 36, 39, 42, 44, 46, 48, 50, 52, 54, 56, 58 and 60;

- (b) an amino acid sequence encoded by a nucleic acid sequence as shown in any of SEQ ID NOs: 1, 3, 7, 9, 11, 13, 15, 17, 19, 29, 35, 38, 41, 43, 45, 47, 49, 51, 53, 55, 57 and 59;

- (c) an amino acid sequence encoded by a nucleic acid sequence hybridizing with the complementary strand of a nucleic acid sequence as defined in (b) under stringent hybridization conditions;

- (d) an amino acid sequence encoded by a nucleic acid sequence which is degenerate as a result of the genetic code to a nucleotide sequence of any one of (b) and (c).

13. The pharmaceutical composition comprising a nucleic acid sequence encoding a bispecific single chain antibody construct as defined in any of claims 1 to 12.

14. The pharmaceutical composition comprising a vector which comprises a nucleic acid sequence as defined in claim 13.
- 5 15. The pharmaceutical composition of claim 14, wherein said vector further comprises a regulatory sequence which is operably linked to said nucleic acid sequence defined in claim 13.
- 10 16. The pharmaceutical composition of claim 14 or 15, wherein said vector is an expression vector.
17. A pharmaceutical composition comprising a host transformed or transfected with a vector defined in any of claims 14 to 16.
- 15 18. A pharmaceutical composition according to any of claims 1 to 17, further comprising a proteinaceous compound capable of providing an activation signal for immune effector cells.
- 20 19. The pharmaceutical composition of any of claims 1 to 18, wherein the pharmaceutical composition is thermostable at  $\geq 37^{\circ}\text{C}$ .
- 25 20. A process for the production of a pharmaceutical composition according to any of claims 1 to 19, said process comprising culturing a host defined in claim 17 under conditions allowing the expression of the bispecific single chain antibody construct as defined in any of claims 1 to 12 and recovering the produced bispecific single chain antibody construct from the culture.
- 30 21. Use of a bispecific single chain antibody construct as defined in any of claims 1 to 12, a nucleic acid sequence as defined in claim 13, a vector as defined in any of claims 14 to 16, a host as defined in claim 17 and/or produced in by a process according to claim 20 for the preparation of a pharmaceutical composition for the prevention, treatment or amelioration of

a tumorous disease.

22. A method for the prevention, treatment or amelioration of a tumorous disease, comprising the step of administering to a subject in need of such a prevention, treatment or amelioration a pharmaceutical composition of any of claim 1 to 19.
23. The method of claim 22, wherein said subject is a human.
24. The use of claim 21 or the method of claim 22 or 23, wherein said tumorous disease is epithelial cancer or a minimal residual cancer.
25. A kit comprising a bispecific single chain antibody construct as defined in any of claims 1 to 12, a nucleic acid sequence as defined in claim 13, a vector as defined in any of claims 14 to 16, a host as defined in claim 17 and/or produced in by a process according to claim 20.



Figure 1

## A) anti-CD3 VHVL stL x 3-1 VHVL (SEQ ID NO: 11)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAATCCTAGCCGTGTTATACTAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATGCTTACTGCTTACTGCTTACTGCTTACTGCTTACTGCTTACTGCTTACTGCTT  
CTGGCGGCGGCTCCGGTGGTGGTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCAATCT  
CCAGGGGAGAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACTGGTACCAGCAGAAGTC  
AGGCACCTCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCTTCAGTGGCA  
GTGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGGTGGTGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GGTGCAGCTGCTCGAGCAGTCTGGAGCTGGTGAACCTGGGGCCTCAGTGAAGATATCCTGCAAGGCTT  
CTGGATACGCCCTTCACTAATGCTAGGTGGTAAAGCAGAGGCCCTGGACATGGACTTGAGTGGATTGGA  
GATCTTTTCCCTGGAAGTGGTAATCACTACAAATGAGAGGTTCAAGGGCAAAGCCACACTGACTGCAGACAA  
ATCCTCGAGCACAGCCTTTATGCAGCTCAGTAGCCTGACATCTGAGGACTCTGCTGTCTATTCTGTGCAAGAT  
TGAGGAACTGGGACGAGGCTATGGACTACTGGGGCCAAGGACCAGGTCAACCGTCTCCTCAGGTGGTGGT  
TCTGGCGGCGGCTCCGGTGGTGGTCTGAGCTCGTCAATGACCCAGTCTCCATCTTATCTTGTGCTGCATC  
TCCTGGAGAAACCATTAATAATTCAGGGCAAGTAAGAGCATTAGCAAATATTAGCCTGGTATCAAGAGA  
AACCCTGGGAAACTAATAAGCTTCTTATCTACTCTGGATCCACTTTGCAATCTGGAATTCATCAAGGTTCAGT  
GGCAGTGGATCTGGTACAGATTTCACTCTCACCATCAGTAGCCTGGAGCCTGAAG

## Figure 1 A) continued

ATTTTGAATGTATTACTGTCAACAGCATAATGAATATCCGTACACGTTCCGAGGGGGACCAAGCTTGAGATC  
AAACATCATCACCATCATCATTAG

## (SEQ ID NO: 12)

DIKLQOQGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQKFKDKATLTTDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSGGGGGGGGSDIQLTQSPAIMSAS  
PGEKVMTCRASSVS YMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGGTSYSLTSSMEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKSGGGGSEVQLLEQSGAELVKPGASVKISCKASGYAFTNYWLGWVKQRPQGHGLEWIG  
DLFPGSGNTHYNERFRGKATLTADKSSSTA F MQLSSLTSEDSAVYFCARLRNWD EAMDYWGQGTTVTVSSGGGG  
SGGGSGGGSELVMTQSPSYLAASPGETITINCRASKSISKYLAWYQEKPGKTNKLLIYSGSTLQSGIPSRFS  
GSGSGTDFTLTSSLEPEDEFAMYQCQQHNEYPYTFGGGGTKLEIKHHHHHH

## Figure 1

## B) anti-CD3 VHVL aL x 4-7 VHVL (SEQ ID NO:1)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACCTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATACTAATTACAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATGCTTGAATGCTGGGGCAAGCCACTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
GTGGAGGTTCTGTTGGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCATCTCCAGGGAGAAGGTACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAAGTGTACCA  
GCAGAAGTCAGGCACCTCCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCT  
TCAGTGGCAGTGGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTTCGGTCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGCGAGGCCCTGGGGCTTCAGTGAAGCTGTCTCT  
GCAAGGCTTCTGGCTACACCTTCACAAACTATGGTTAAGCTGGGTGAAGCAGAGGCCCTGGACAGGTCTCTTGAG  
TGGATTGGAGAGGTTTATCCCTAGAAATTGGTAATGCTTACTACAATGAGAAGTTCAAGGGCAAGGCCACACTGAC  
TGCAGACAAATCCTCCAGCACAGCGTCCATGGAGCTCCGAGCCTGACCTCTGAGGACTCTGCGGTCTATTCT  
GTGCAAGACGGGATCCTACGATACTAAGTACGACTGGTACTCTGGGGCCAAAGGACCAAGGTCAAGTCAAG  
GTCTCCTCAGGTGGTGGTCTGGCGGCGGCTCCGGTGGTGGTCTGAGCTCGTGTGATGATGATGATGATGATGAT  
TCCACTCTCCCTGCTCAGTCTTGGAGATCAAGCCCTCCATCTCTTGCAGATCTAGTCAGAGCCTTGTACACA  
GTAATGGAAACACCTATTACATTGGTACCTGCAGAAGCCAGGCCAGTCTCCAAAG

Figure 1 B) continued

CTCCTGATCTACAAGTTTCCAACCGATTTCTGGGGTCCAGACAGGTTCAAGTGGAGTGGATCAGGACAGAG  
TTTCACTCAAGATCAGCAGAGTGGAGCTGAGGATCTGGAGTTATTCTGCTCTCAAAGTACACATGTTT  
CGTACACGTTCCGAGGGGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

(SEQ ID NO: 2)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQKFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSVEGGSGGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPRFSGSGTSYSLTSSMEAEADAATY  
YCQOWSSNPLTFGAGTKLELKSGGGSEVQLLEQSGAELARPGASVKLSCKASGYTFTNYGLSWVKQRPQVLE  
WIGEVYPRIGNAYYNEKFKGKATLTADKSSSTASMELRSLTSEDSAVYFCARRGSYDNTYDWYFDVWGQGTVT  
VSSGGGGGGGGGGSELVMTQTPSLPVSIGDQASISCRSSQSLVHSNGNTYLHWYLOKPGQSPKLLIYKV  
SNRFGVDPDRFSGSGGTDFTLKISRVEAEDLGVFYFCSQSTHVPYTFGGGTKLEIKHHHHHH



Figure 1

## C) anti-CD3 VHVL aL Ser x 4-7 VHVL (SEQ ID NO: 7)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACCTGGGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATACTAATTACAATCAGAAGTTCAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTTACTCCCTTGACTACTGGGGCCAAGGCACCTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
GTGGAGGTTCTGGTGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCATCTCCAGGGAGAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAAGTGGTACCA  
GCAGAAGTCAGGCACCTCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCT  
TCAGTGGCAGTGGGCTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTGTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGCGAGGCCCTGGGCTTCAGTGAAGCTGTCCCT  
GCAAGGCTTCTGGCTACACCTTCACAAACTATGGTTAAAGCTGGGTGAAGCAGAGGCCCTGGACAGGTCCCTTGAG  
TGGATTGGAGAGGTTTATCCTAGAATTGGTAATGCTTACTACAATGAGAAGTTCAGGGCAAGGCCACACTGAC  
TGCAAGACAAATCCTCCAGCACAGCGTCCATGGAGCTCCGACCTGACCTCTGAGGACTCTGCGGTCTATTCT  
GTGCAAGACGGGATCCTACGATACTACGACTGGTACTTCGATGTCTGGGCCAAGGGACCAAGGTCCACC  
GTCCTCCTCAGGTGGTGGTCTCTGGCGGGCGGCTCCGGTGGTGGTCTGAGCTCGTGTGATGACCCAGAC  
TCCACTCTCCCTGCCCTGTCACTCTGGAGATCAAGCCTCCATCTCTTGCAGATCTAGTCAGAGCCTTGTACACA  
GTAATGGAAACACCTATTACATTTGTTACCTGCAGAAGCCAGGCCAGTCTCCAAGCTCCTGATCTACAAAGTT  
TCCAACCGATTTCTGGGGTCCCAGACAGGTTTCAAGTGGCAGTGGATCAGGGACAG

## Figure 1 C) continued

ATTTCACACTCAAGATCAGCAGAGTGGAGGCTGAGGATCTGGAGTTTATTCTGCTCTCAAAGTACACATGTT  
CCGTACACGTTCCGAGGGGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

## (SEQ ID NO: 8)

DIKLQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKORPGQGLEWIGYINPSRGYTNYNQFKDKATLTTDK  
SSSTAYMQLSSLTSEDSAVYYCARYDDHYSLDYWGQGTTLTVSSVEGGSGGSGGVDDIQLTQSPAIM  
SASPGKVTMTCRASSVSVMNYYQOKSGTSPKRWIYDTSKVASGVPYRFSGSGSGTSYSLTISSEAEADAATY  
YCQQWSSNPLTFGAGTKLELKSGGGSEVQLLEQSGAELARPGASVKLSCKASGYTFNYGLSWVKQRPQGVLE  
WIGEVYPRIGNAYYNEKFKGKATLTADKSSSTASMELRSLTSEDSAVYFCARRGSYDTNYDWFVDWVGQGTTVT  
VSSGGGSGGGGGSELVMTQTPLSLPVSLGDQASISCRSSQSLVHSNGNTYLHWYLOKPGQSPKLLIYKV  
SNRFSGVPRDRFSGSGGTDFTLKISRVEAEDLGVYFCSSQSTHVPYTFGGGTKLEIKHHHHH

## Figure 1

## D) anti-CD3 VHVL sL x 4-7 VHVL (SEQ ID NO: 13)

GATATCAAACTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGTAAACAGAGGCCCTGGACAGGGTCTGGAAATGGATTGGAT  
ACATTAAATCCTAGCCGTGGTTATACTAATTACAATCAGAAGTTCAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTA CTG CCTT GACTACTGGGGCCAAGGCACCTCTCACAGTCTCCTCAGGTGGTGGTGGTT  
CTGGCGGGCGGCTCCGGTGGTGGTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCATCT  
CCAGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTCAAGTGTAACTTACATGAAGTGGTACCAGCAGAAGTC  
AGGCACCTCCCCAAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCTTCAGTGGCA  
GTGGTCTGGGACCTCATACTCTCTCACAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGGTGTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GGTGAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGCGAGGCCCTGGGCTTCAGTGAAGCTGTCTCTGCAAGGCTT  
CTGGCTACACCTTCACAAACTATGGTTTAAGCTGGTGAAGCAGAGGCCCTGGACAGGTCTTGAAGTGGATTGGA  
GAGGTTATCCTAGAATTGGTAATGCTTACTACAATGAGAAGTTCAAGGGCAAGGCCACACTGACTGCAGACAA  
ATCCTCCAGCACAGCGTCCATGGAGCTCCGCAGCCTGACCTCTGAGGACTCTGCGGTCTATTCTGTGCAAGAC  
GGGATCCTACGATACTAATACTACGACTGGTACTTCGATGTCTGGGGCCAAGGGACCCAGGTCAACCTCTCTCA  
GGTGGTGGTGGTCTGGCGGGCGGCTCCGGTGGTGGTCTGAGCTCGTGATGACCCAGACTCCACTCTC  
CCTGCCCTGTCAGTCTTGGAGATCAAGCCTCCATCTCTTGCAGATCTAGTCAGAGCCTTGTACACAGTAATGGAA  
ACACCTATTTACATTGGTACCTGCAGAAGCCAGGCCAGTCTCCAAGCTCCTGATCTACAAAGTTTCCAACCGA  
TTTTCTGGGTCCCAGACAGGTTTCAAGTGGCAGTGGATCAGGACAGATTTCACAC

## Figure 1 D) continued

TCAAGATCAGCAGAGTGGAGGCTGAGGATCTGGGAGTTTATTCTGCTCTCAAAGTACACATGTTCCGTACACG  
TTCGGAGGGGACCAAGCTTGAGATCAAAACATCATCACCATCATCATTAG

(SEQ ID NO: 14)

DIKLQOSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQGLEWIGYINPSRGYTNYNQKFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSGGGGGGGGSDIQLTQSPAIMSAS  
PGEKVMTTCRASSVS YMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGTSSYSLTSSMEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKSGGGGSEVQLLEQSGAELARPGASVKLSCKASGYTFFTNYGLSWVKQRPQGVLEWIG  
EVYPRIGNAYYNEKFKGKATLTADKSSSTASMELRSLTSEDSAVYFCARRGSDTNYDWYFDVWGQGTFTVTVSS  
GGGGSGGGGGSELVMTQTPLSLPVSLGDQASISCRSSQSLVHSNGNTYLVHWYLOKPKGQSPKLLIYKVSNR  
FSGVPRDPSGSGGTDFTLKISRVEAEDLGVFCSQSTHVPYTFGGGTKLEIKHHHHHH



## Figure 1

## E) anti-CD3 VHVL stL x 4-7 VLVH (SEQ ID NO: 15)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAAATGGATTGGAT  
ACATTAAATCCTAGCCGTGGTTATACTAATTAACAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTTACTGCCCTTGACTACTGGGGCCAAGCACCACTCTCACAGTCTCCTCAGGTGGTGGTT  
CTGGCGGGCGGCTCCGGTGGTGGTTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCATCT  
CCAGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTCAAGTGTAAGTTACATGAAGTGGTACCAGCAGAAAGTC  
AGGCACCTCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCTTCAGTGGCA  
GTGGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGTGCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GCTCGTGATGACCCAGACTCCACTCTCCCTGCCCTGTCACTCTGGAGATCAAGCCTCCATCTCTTGCAGATCTA  
GTCAGAGCCTTGTAACACAGTAATGGAACACACCTATTACATTTGGTACCTGCAGAAGCCAGGCCAGTCTCCAAG  
CTCCTGATCTACAAAGTTTCCAACCGATTCTGGGTCCCAGACAGGTTCAAGTGGCAGTGGATCAGGGACAGA  
TTTCACACTCAAGATCAGCAGAGTGGAGGCTGAGGATCTGGGAGTTTATTCTGCTCTCAAAGTACACATGTTT  
CGTACACGTTCCGAGGGGGACCAAGCTTGAGATCAAAGTGGTGGTCTTCTGGCGCGCGGCTCCGGTGGT  
GGTGGTCTGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCGGCTGGGGCTTCAGTGAAGCTGTC  
CTGCAAGGCTTCTGGCTACACCTTCACAAACTATGGTTTAAGCTGGTGAAGCAGAGGCCCTGGACAGGTCTTG  
AGTGGATTGGAGAGGTTTATCCTAGAAATGGTAATGCTTACTACAATGAGAAGTTCAAGGGCAAGGCCACACTG  
ACTGCAGACAAATCCTCCAGCACAGCGTCCATGGAGCTCCGCAGCCTGACCTCTG

## Figure 1 E) continued

AGGACTCTGCGGTCTATTCTGTGCAAGACGGGATCCTACGATACTAACTAGGTACTTCGATGTCCTGG  
GGCCAAGGACCACGGTCAACCGTCTCCTCACATCATCACCATCATCATTAG

## (SEQ ID NO: 16)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQFKDKATLTTDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQTTLTVSSGGGGGGGGSDIQLTQSPAIMAS  
PGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSTSYSLTISSEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKSGGGSELVMTQTPLSLPSLGDQASISCRSSQSLVHSNGNTYLHWYLOKPGQSPK  
LLIYKVSNRFSGVPDRFSGSGGTDFTLKISRVEAEDLGVFCSQSTHVPYTFGGGTKLEIKGGGGSGGGSGG  
GGSEVQILLEQSGAELARPGASVKLSCKASGYTFITNYGLSWVKQRPQGVLEWIGEVYPRIGNAYYNEKFKGKATL  
TADKSSSTASMELRSLTSEDSAVYFCARRGSDYDITNYDWYFDVWGQGTITVSSHHHHH

## Figure 1

## F) anti-CD3 VHVL aL x 5-10 VHVL (SEQ ID NO: 3)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTTATACTAATACAGAAATCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATGCTGCTGACTACTGGGGCCAAGGCACCACTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
GTGGAGGTTCTGGTGGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCATCTCCAGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACCTGGTACCA  
GCAGAACTCAGGCACCTCCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCT  
TCAGTGGCAGTGGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTGGTGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTAAGCCTGGGACTTCAGTGAAGATATCCT  
GCAAGGCTTCTGGATACGCCCTTCACTAACTAGCTGGCTAGGTTGGGTAAGCAGAGGCCCTGGACATGGACTTGAG  
TGGATTGGAGATATTTCCCTGGAAAGTGGTAATATCCACTACAATGAGAAGTCAAGGGCAAGCCACACTGAC  
TGCAGACAAATCTTCGAGCACAGCCTATATGCAGCTCAGTAGCCTGACATTTGAGGACTCTGCTGTCTATTCT  
GTGCAAGACTGAGGAACTGGGACGAGCCTATGGACTACTGGGCCAAGGGACCAAGGTCAACGTCCTCCTCAGGT  
GGTGGTGGTTCTGGCGGGCGGCTCCGGTGGTGGTCTGAGCTCGTGATGACACAGTCTCCATCCTCCCT  
GACTGTGACAGCAGGAGAGAAGTCACTATGAGCTGCAAGTCCAGTCAGAGTCTGTAAACAGTGGAATCAAA  
AGAACTACTTGACCTGGTACCAGCAAGAACAGGCCCTCCTAAACTGTTGATCTACTGGGCATCCACTAGG  
GAATCTGGGTCCCCTGATCGCTTCACAGGCAGTGGATCTGGAACAGATTTCACTC

## Figure 1 F) continued

TCACCATCAGCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTCAGAATGATTATAGTTATCCGCTCACG  
TTCGGTGCTGGACCAAGCTTGAGATCAAACATCATCACCATCATCATAG

## (SEQ ID NO: 4)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPGQGLEWIGYINPSRGYTNYNQFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSVEGGSGGSGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSVS YMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSGTSYSLTISSEAEADAATY  
YCQQWSSNPILTFGAGTKLELKSGGGSEVQLLEQSGAELVRPGTSVKISCKASGYAFNRYWLGWVKQRPGHGLE  
WIGDIFPGSGNIHYNEKFKGKATLTADKSSSTAYMQLSSLTFEDSAVYFCARLRNWDYWGQGTITVTVSSG  
GGSGGGSGGGSELVMTQSPSSLTVTAGEKVTMSCKSSQLNSGNQKNYLTWYQQKPGQPPKLLIYWASTR  
ESGVPPDRFTGSGSGTDFTLTITSSVQAEDLAVYYCQNDYSYPLTFGAGTKLEIKHHHHH



Figure 1

## G) anti-CD3 VHVL aL Ser x 5-10 VHVL (SEQ ID NO: 9)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATATACTAATACAAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATCCCTTGACTACTGGGGCCAAGCACCACTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
GTGGAGGTTCTGGTGGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCATCTCCAGGGAGAAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACCTGGTACCA  
GCAGAAGTCAGGCACCTCCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCT  
TCAGTGGCAGTGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGTGCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTAAGCCTGGGACTTCAGTGAAGATATCCT  
GCAAGGCTTCTGGATACGCCCTTCACTAACTAGCTAGGTTGGGTAAGCAGAGGCCCTGGACATGGACTTGAG  
TGGATTGGAGATATTTCCCTGGAAAGTGGTAATATCCACTACAATGAGAAGTCAAGGGCAAGCCACACTGAC  
TGCAGACAAATCTTCGAGCACAGCCTATATGCAGCTCAGTAGCCTGACATTTGAGGACTCTGCTGTATTCT  
GTGCAAGACTGAGGAACCTGGGACGAGCCTATGGACTACTGGGCCAAGGACCACGGTCACCGTCTCCTCAGGT  
GGTGGTGGTCTGGCGGGGCTCCGGTGGTGGTCTGAGCTCGTGATGACACAGTCTCCATCCTCCCT  
GACTGTGACAGCAGGAGAGAAGTCACTATGAGCTGCAAGTCCAGTCAGAGTCTGTAAACAGTGGAAATCAAA  
AGAACTACTTGACCTGGTACCAGCAAAACCAGGCAGCCTCCTAAACTGTTGATC



## Figure 1 G) continued

TACTGGGCATCCACTAGGAATCTGGGTCCCTGATCGCTTACAGGCAGTGGATCTGGAACAGATTCACTCT  
CACCATCAGCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTCAGAATGATTATAGTTATCCGCTCACGT  
TCGGTGCTGGGACCAAGCTTGAGATCAAACATCATCACCATCATTAG

## (SEQ ID NO: 10)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQFKDKATLTDDK  
SSSTAYMQLSLTSSEDSAVYYCARYYDDHYSLDYWGQGTTLTVSSVEGGSGGSGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSSVSVMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSGTSYSLTISSEAEADAATY  
YCQQWSSNPLTFFAGTKLELKSGGGSEVQLLLEQSGAELVRPGTSVKISCKASGYAFNYYWLVKQRPQGHGLE  
WIGDIFPGSGNIHYNEKFKGKATLTADKSSSTAYMQLSLTFEDSAVYFCARLRNWDPEMDYWGQGTTVTVSSG  
GGSGGGSGGGSELVMTQSPSSLTVTAGEKVTMSCKSSQSLNSGNQKNYLTWYQQKPGQPPKLLIYWASTR  
ESGVPDRFTGSGSGTDFTLTISSVQAEDLAVYYCQNDYSYPLTFFAGTKLEIKHHHHHH

## Figure 1

## H) anti-CD3 VHVL stL x 5-10 VHVL (SEQ ID NO: 17)

GATATCAAAC TGACAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACAGAGGGCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGGTTATACTAATAATTACAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCCTACATGCAACTGAGCAGCCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTA TACTGCCCTTGACTACTGGGGCCAAGCACCACTCTCACAGTCTCCTCAGGTGGTGGTGT  
CTGGCGGGCGGCTCCGGTGGTGGTGTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCATCT  
CCAGGGAGAAAGTCA CCAATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAAGTGGTACCAGCAGAAGTC  
AGGCACCTCCCCCAA AAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCTTCAGTGGCA  
GTGGGTCTGGGACCTCATACTCTCTACAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGGTGGTGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTAAGCCCTGGGACTTCAGTGAAGATATCCTGCAAGGCTT  
CTGGATACGCCCTTCACTAACTACTGGCTAGGTTGGGTAAGCAGAGGCCCTGGACATGGACTTGAGTGGATTGGA  
GATAATTTCCCTGGAAGTGGTAATATCCACTACAATGAGAAGTTCAAGGGCAAAGCCACACTGACTGCAGACAA  
ATCTTCGAGCACAGCC TATATGCAGCTCAGTAGCCTGACATTTGAGGACTCTGCTGTCTATTCTGTGCAAGAC  
TGAGGAACTGGGACGAGCC TATGGACTACTGGGGCCAAGGACCACGGTCACCGTCTCCTCAGGTGGTGGTGGT  
TCTGGCGGGCGGCTCCGGTGGTGGTGTCTGAGCTCGTGATGACACAGTCTCCATCCCTGACTGTGAC  
AGCAGGAGAGAAGGTCACTATGAGCTGCAAGTCCAGTCAGAGTCTGTTAAACAGTGGAAATCAAAAGAACTACT  
TGACCTGGTACCAGCAGAAAC CAGGCAGCCCTCCTAAACTGTTGATCTACTGGGCATCCACTAGGGAATCTGGG  
GTCCCTGATCGCTTCACAGGCAGTGGATCTGGAACAGATTTCACTCTCACCATCA

## Figure 1 H) continued

GCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTGAGAAATGATTATAGTTATCCGCTCACGTTTCGGTGCT  
GGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

## (SEQ ID NO: 18)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQGLEWIGYINPSRGYTNYNQFKDKATLLTSDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSGGGGGGGGSDIQLTQSPAIMSAS  
PGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGGTSYSLTISSEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKS GGGGSEVQLLEQSGAELVRPGTSVKISCKASGYAFTNFWLVKQRPQGHGLEWIG  
DIFPGSGNIHYNEKFKGKATLTADKSSSTAYMQLSSLTFEDSAVYFCARLRNWDEPMDYWGQGTTLTVSSGGGG  
SGGGSGGGSELVMTQSPSSLTVTAGEKVTMSCKSSQSLNSGNQKNYLTWYQQKPGQPPKLLIYWASTRESG  
VPDRFTGSGSGTDFLTITSSVQAEDLAVYYCQNDYSYPLTFGAGTKLEIKHHHHHH

# Figure 1

I) anti-CD3 VHVL<sub>stL</sub> x 5-10 VL<sub>VH</sub> (SEQ ID NO: 19)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGCCCTCAGTGAAGATGTCTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATATACTAATTACAATCAGAAGTTC AAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTA CTGCTTGACTACTGAGCTACTGGGCCAAGCACCTCTCACAGTCTCCTCAGGTGCTGCTGGTT  
CTGGCGGCGGCTCCGGTGGTGGTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCAATCT  
CCAGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTC AAGTGTAACTGAACCTGTAACCAGCAGAAGTC  
AGGCACCTCCCCAAAGATGGATTTATGACACATCCAAGTGGCTTCTGGAGTCCCTTATCGCTTCAGTGGCA  
GTGGTCTGGGACCTCATACTCTCTCACAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGGTCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GCTCGTGATGACACAGTCTCCATCCTCCCTGACTGTGACAGCAGGAGAGGTCACTATGAGCTGCAAGTCCA  
GTCAGAGTCTGTTAAACAGTGGAAATCAA AAGAACTACTTGACCTGGTACCAGCAGAAACCAGGGCAGCCTCCT  
AAACTGTTGATCTACTGGGCATCCACTAGGGAATCTGGGTCCCTGATCGCTTCACAGGCAGTGGATCTGGAAC  
AGATTTCACCTCACCATCAGCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTCAGAATGATTATAGTT  
ATCCGCTCACGTTCCGGTGTGGGACCAAGCTTGAGATCAAAGGTGGTGGTCTCTGGCGGCGGCTCCGGT  
GGTGGTGGTTCTGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTAAGCCTGGGACTTCAGTGAAGAT  
ATCCTGCAAGGCTTCTGGATACGCCCTTCACCTAACTACTGGCTAGGTTGGTAAAGCAGAGGCCCTGGACATGGAC  
TTGAGTGGATTGGAGATATTTCCCTGGAA GTGCTAATATCCACTACAATGAGAAGTTC AAGGGCAAAGCCACA  
CTGACTGCAGACAAATCTTCGAGCACAGCCCTATATGCAGCTCAGTAGCCCTGACAT.

## Figure 1 D) continued

TTGAGGACTCTGCTGTCTATTCTGTGCAAGACTGAGGAAC TGGGACGAGCCTATGGACTACTGGGGCCAAGGG  
ACCACGGTCACCGTCTCCTCACATCATCACCATCATTAG

(SEQ ID NO: 20)

DIKLQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQG LEWIGYINPSRGYTNYNQFKDKATLTTDK  
SSSTAYMQLSLTSSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSGGGGGGGGSDIQLTQSPAIMSAS  
PGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSGTSYSLTISSEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKS GGGSELVMTQSPSSLTVTAGEKVTMSCKSSQSLNSGNQKNYLTWYQQKPGQPP  
KLLIYWASTRESGVPRDFTGSGSGTDFTLTISVQAE DLAVYYCQNDYSYPLTFGAGTKLEIKGGGGSGGGSG  
GGGSEVQLLEQSGAELVRPGTSVKISCKASGYAF TNYWLGWVKQRPQGHGLEWIGDIFPGSGNIHYNEKFKGKAT  
LTADKSSSTAYMQLSLTFEEDSAVYFCARLRNWDEPMDYWGQGT TVTSSHHHHHH



Figure 1

## J) anti-CD3 VHVL aL x 3-1 VHVL (SEQ ID NO: 45)

GATATCAAACTGCAGCAGTCAGGGGCTGAACCTGGCAAGACCTGGGGCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATACTAATTACAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTTACTGCCCTTGACTACTGGGCCAAGGCCACTCTCACAGTCTCCTCAGTCCGAAGGTGGAA  
GTGGAGGTTCTGGTGGAGGTGGAGGTTCAAGTGGAGTCCAGCAGCATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCATCTCCAGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACCTGGTACCA  
GCAGAAAGTCAGGCACCTCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCT  
TCAGTGGCAGTGGGTCCTGGGACCTCATCTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTGTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTGAAACCTGGGCCCTCAGTGAAGATATCCT  
GCAAGGCTTCTGGATACGCCCTTCACTAACTACTGGCTAGGTTGGGTAAAGCAGAGGCCCTGGACATGGACTTGAG  
TGGATTGGAGATCTTTCCCTGGAAGTGGTAATACTACTACAATGAGAGGTTCAGGGGCAAGCCACACTGAC  
TGCAGACAAATCCTCGAGCACAGCCTTTATGCAGCTCAGTAGCCTGACATCTGAGGACTCTGCTGTATTCT  
GTGCAAGATTGAGGAACCTGGGACGAGGCTATGGACTACTGGGCCAAGGGACCGGTCAACCTCCTCAGGT  
GGTGGTGGTTCTGGCGGGCGGCTCCGGTGGTGGTCTGAGCTCGTCAAGCCAGTCTCCATCTTATCT  
TGCTGCATCTCCTGGAGAAACCATTACTATTAAATTGCAGGGCAAGTAAGCATTAGCAATAATTTAGCCTGGT  
ATCAAGAGAAACCTGGGAAACATAAAGCTTCTTATCTACTCTGGATCCACTTTGCAATCTGGAATTCATCA  
AGGTTCAGTGGCAGTGGATCTGGTACAGATTTCACTCTCACCATCAGTAGCCTGG

## Figure 1 J) continued

AGCCTGAAGATTTTGCAATGTATTACTGTCAACAGCATAATGAATATCCGTACACGTTCCGAGGGGGACCAAG  
CTTGAGATCAAACATCATCACCATCATCATTAG

## (SEQ ID NO: 46)

DIKLQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQKFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYICARYYDDHYCLDYWGQGTTLTVSSVEGGSGGSGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGTSYSLTSSMEAEADAATY  
YCQQWSSNPLTFGAGTKLELKSGGGSEVQLLEQSGAELVKPGASVKISCKASGYAF'N'YWLGWVKQRPQGHGLE  
WIGDLFPGSGNTHYNERFRGKATLTADKSSSTAFAFMQLSSLTSEDSAVYFCARLRNWDDEAMDYWGQGT'V'TVSSG  
GGSGGGSGGGSELVMTQSPSYLAASPGETITINCRASKSISKYLAWYQEKPGKTNKLLIYSGSTLQSGIPS  
RFGSGSGTDFTLTISSLEPEDEFAMYYCQQHNEYPTFFGGGTKLEIKHHHHHH

Figure 1

## K) anti-CD3 VHVL aL Ser x 3-1 VHVL (SEQ ID NO: 47)

GATATCAAACTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAAGATGTCTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATACTAATTACAATCAGAAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATCCCTTGACTACTGGGCCAAGGCACCTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
GTGGAGGTTCTGGTGGAAGTGGAGGTTCAAGTGGAGTCCAGACATTCAAGTGTAAAGTTACATGAAGTGGTACCA  
TCTGCACTCCAGGGAGAAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTCTGGAGTCCCCTTATCGCT  
GCAGAAAGTCAGGCACCTCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCT  
TCAGTGGCAGTGGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTGTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTGAACCTGGGGCCTCAGTGAAGATATCCT  
GCAAGGCTTCTGGATAACGCTTCACTAAGTGGCTAGGTTGGGTAAAGCAGAGGCCCTGGACATGGACTTGAG  
TGGAATTGGAGATCTTTCCCTGGAGTGTAATACTCACTACAATGAGAGGTTCAAGGGCAAGCCACACTGAC  
TGCAGACAAATCCTCGAGCACAGCCTTTATGCAGCTCAGTAGCCTGACATCTGAGGACTCTGCTGTATTCT  
GTGCAAGATTGAGGAACCTGGGACGAGGCTATGGACTACTGGGCCAAGGACCCAGGTCAACCTCCTCAGGT  
GGTGGTGGTCTGGCGGGCGGCTCCGGTGGTGGTCTGAGCTCGTCAATGACCCAGTCTCCATCTTATCT  
TGCTGCATCTCCTGGAGAAACCATTAATAATTGCAGGGCAAGTAAGAGCATTAGCAATAATTTAGCCTGGT  
ATCAAGAGAAACCTGGGAAACCTAATAAGCTTCTTATCTACTCTGGATCCACTTTG

## Figure 1 K) continued

CAATCTGGAATTCATCAAGGTTCAAGTGGCAGTGGATCTGGTACAGATTTCACTCTCACCATCAGTAGCCTGGA  
GCCTGAAGATTTTGCAATGTATTACTGTCAACAGCATATGAATATCCGTACACGTTCCGGAGGGGGACCAAGC  
TTGAGATCAAACATCATCACCATCATCATTAG

## (SEQ ID NO: 48)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGLEWIGYINPSRGYTNYNQKFKDKATLTDDK  
SSSTAYMQLSLTSEDSAVYYCARYYDDHYSLDYWGQGTTLTVSSVEGGSGGGGGVDDIQLTQSPAIM  
SASPGKVTMTCRASSVSVMNYYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGTSYSLTISSEAEADAATY  
YCQQWSSNPLTFGAGTKLELKSGGGSEVQLLEQSGAELVKPGASVKISCKASGYAFTNFWLGVKQRPQGHGLE  
WIGDLFPGSGNTHYNERFRGKATLTADKSSSTAFAFMQLSSLTSEDSAVYFCARLRNWDAMDYWGQGTTVTVSSG  
GGSGGGSGGGSELVMTQSPSYLAASPGETITINCRASKSISKYLAWYQEKPGKTNKLLIYSGSTLQSGIPS  
RFSGSGTDFTLTISSEPEDEFAMYYCQQHNEYPTFFGGGTKLEIKHHHHH



## Figure 1

## L) anti-CD3 VHVL aL x 3-5 VHVL (SEQ ID NO: 49)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACCTGGCAAGACCTGGGGCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGGTTATATACTAATTACAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATGCTTGAATGCTGGGGCCAAAGCACCCTCTCACAGTCTCCTCAGTCCGAAGGTGGAA  
GTGGAGGTTCCTGGTGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCAATCTCCAGGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACCTGGTACCA  
GCAGAACTCAGGCACCTCCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCT  
TCAGTGGCAGTGGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGGTAAGCCTGGGACTTCAGTGAAGCTGTCTCT  
GCAAGGCTTCTGGCTACACCTTCACAAAGCTATGGTTAAGCTGGGTGAAGCAGAGAACTGGACAGGCCCTTGAG  
TGGATTGGAGAGGTTTATCCTAGAAATGGTAATGCTTACTACAATGAGAAGTTCAAGGCCAAGGCCACACTGAC  
TGCAGACAAATCCTCCAGCACAGCGTCCATGGAGCTCCGCAGCCTGACATCTGAGGACTCTGCGGTCTATTCT  
GTGCAAGACGGGATCCTACGGTAGTAACGACTGGTACTTCGATGTCTGGGGCCAAAGGCCACCGGTCAAC  
GTCTCCTCAGGTGGTGGTCTGGCGGCGGCTCCGGTGGTGGTCTGAGCTCGTGAATGACCCAGAC  
TCCACTCTCCCTGCTCAGTCTTGGAGATCAAGCCTCCATCTCTTGCAGATCTAGTCAGAGCCTTGTACACA  
GTAATGGAACACCTATTACATTTGGTACCTGCAGAAGCCAGGCCAGTCTCCAAGCTCCTGATCTACAAAGTT  
TCCAACCGATTTCTGGGTCCCAGACAGGTTTCAGTGGCAGTGGATCAGGGACAG



## Figure 1 L) continued

ATTTCACACTCAAGATCAGCAGAGTGAGGCTGAGGATCTGGGAGTTTATTCTGCTCTCAAAGTACACATGTT  
CCGTACACGTTCCGAGGGGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

(SEQ ID NO: 50)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPGQGLEWIGYINPSRGYTNYNQFKDKATLTTDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSVEGGSGGSGGVDDIQLTQSPAIM  
SASPGEKVMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSTSYSLTIS\$MEAE\$DAATY  
YCQQWSSNPLTFAGTKLELKS\$GGGSEVQLLEQSGAELVRPGTSVKLSCKASGYTF\$TSYGLSWVKQRTGQGLE  
WIGEVYPRIGNAYYNEKFKGKATLTADKSSSTAS\$MELRSLTSEDSAVYFCARRGSYGSNYDWF\$DVGWQGT\$T\$VT  
VSSGGGSGGGGSGGSELVMTQTPLSLPVSLGDQASISCRSSQSLVHSNGNTYLHWY\$LOKPGQSPKLLIYKV  
SNRFSGV\$PDRFSGSGGTDF\$TLKISRVEAEDLG\$VFCSQ\$STHVPYTFGGG\$TKLEIKHHHHH

Figure 1

M) anti-CD3 VHVL aL Ser x 3-5 VHVL (SEQ ID NO: 51)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
 TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
 ACATTAAATCCTAGCCGTGGTTAATACTAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
 TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
 TTATGATGATCATTAATCCCTTGAATACTGGGGCCAAAGGCACCTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
 GTGGAGGTTCTGGTGAAGTGAGGTTGAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
 TCTGCATCTCCAGGGGAGAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACCTGGTACCA  
 GCAGAAGTCAGGCACCTCCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCT  
 TCAGTGGCAGTGGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
 TACTGCCAACACAGTGGAGTAGTAACCCGCTCACGTTCCGTTGGTGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
 TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGGTAAGCCCTGGGACTTCAGTGAAGCTGTCTCT  
 GCAAGGCTTCTGGCTACACCTTCACAAGCTATGGTTAAGCTGGTGAAGCAGAGAACTGGACAGGGCCTTGAG  
 TGGATTGGAGAGGTTTATCCTAGAAATGGTAATGCTTACTACAAATGAGAAGTTCAAGGGCAAGGCCACACTGAC  
 TGCAGACAAATCCTCCAGCACAGCGTCCATGGAGCTCCGCAGCCTGACATCTGAGGACTCTGCCGTCTATTCT  
 GTGCAAGACGGGATCCTACGGTAGTAACGACTGGTACTTCGATGTCTGGGGCCAAAGGGACCCACGGTCACC  
 GTCTCCTCAGGTGGTGGTTCTGGCGCGGGCTCCGGTGGTGGTCTGAGCTCGTGATGACCCAGAC  
 TCCACTCTCCCTGCTCAGTCTTGGAGATCAAGCCTCCATCTCTTGCAGATCTAGTCAGAGCCTTGACACA  
 GTAATGGAAACACCTATTACATTGGTACCTGCAGAAGCCAGGCCAGTCTCCAAGCTCCTGATCTACAAAGTT  
 TCCAACCGATTCTGGGTCCCAGACAGGTTCAGTGGCAGTGGATCAGGGACAG

## Figure 1 M) continued

ATTTCACACTCAAGATCAGCAGAGTGGAGGCTGAGGATCTGGAGTTATTCTGCTCTCAAAGTACACATGTT  
CCGTACACGTTCCGAGGGGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

(SEQ ID NO: 52)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYSLDYWGQGTTLTVSSVEGGSGGGGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSVSVMNYYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSTSYSLTSSMEAEADAATY  
YCQQWSSNPLTFGAGTKLELKS GGGSEVQLLEQSGAELVRPGTSVKLSCKASGYTFTSYGLSWVKQRTGQGLE  
WIGEVYPRIGNAYYNEKFKGKATLTADKSSSTASMELRSLTSEDSAVYFCARRGSYGSNYDWFVDVWGQGTTVT  
VSSGGGSGGGGGSELVMTQTPLSLPVS LGDQASISCRSSQSLVHSNGNTYLHWY LQKPGQSPKLLIYKV  
SNRFSGVDPDRFSGSGGTDEFTLKISRVEAEDLGVYFC SQSTHPVYTFGGGTKLEIKHHHHH

Figure 1

## N) anti-CD3 VHVL sL x 3-5 VHVL (SEQ ID NO: 53)

GATATCAAACTGCAGCAGTCAGGGGCTGAACCTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGTAAACACAGAGGCTGGACAGGCTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTATATACTAATTACAATCAGAAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATGCTTGAATGCTGGGCAAGGCACTCTCACAGTCTCTCAGGTGGTGGTGGTT  
CTGGCGGCGGCTCCGGTGGTGGTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCATCT  
CCAGGGAGAAGGTCAACCATGACCTGCAGAGCCAGTTCAAAGTGTAAAGTTACATGAACCTGGTACCAGCAGAAGTC  
AGGCACCTCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCTTCAGTGGCA  
GTGGTCTGGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGTGCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GGTGAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTAAGCCTGGGACTTCAGTGAAGCTGTCTCTGCAAGGCTT  
CTGGCTACACCTTCACAAGCTATGGTTAAGCTGGGTGAAGCAGAGAACTGGACAGGGCCTTGAGTGGATTGGA  
GAGGTTTATCCTAGAAATTGGTAATGCTTACTACAATGAGAAAGTTCAAGGGCAAGGCCACACTGACTGCAGACAA  
ATCCTCCAGCACAGCGTCCATGGAGCTCCGCAGCCTGACATCTGAGGACTCTGCGGTCTATTCTGTGCAAGAC  
GGGATCCTACGGTAGTAACACTACGACTGGTACTTCGATGTCTGGGGCCAAGGACCACGGTCACCGTCTCCTCA  
GGTGGTGGTGTCTGGCGGCGGCTCCGGTGGTGGTCTGAGCTCGTGATGACCCAGACTCCACTCTC  
CCTGCCCTGCAGTCTTGGAGATCAAGCCTCCATCTTTGCAGATCTAGTCAGAGCCTTGACACAGTAATGGAA  
ACACCTATTACATTTGGTACCTGCAGAAGCCAGGCCAGTCTCCAAGCTCCTGATCTACAAAGTTTCCAACCGA  
TTTTCCTGGGTCCCAGACAGGTTTCAGTGGCAGTGGATCAGGGACAGATTTCACAC

## Figure 1 N) continued

TCAAGATCAGCAGAGTGAGGCTGAGGATCTGGAGTTTATTTCTGCTCTCAAAGTACACATGTTCCGTACACG  
TTCGAGGGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

## (SEQ ID NO: 54)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQGLEWIGYINPSRGYTNYNQFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYYCARYDDHYCLDYWGQGTTLTVSSGGGGGGGGSDIQLTQSPAIMAS  
PGEKVTMTCRASSVSVMNYYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGTSYSLTSSMEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKS GGGSEVQLLEQSGAELVRPGTSVKLSCKASGYTFTSYGLSWVKQRTGQGLEWIG  
EVYPRIGNAYYNEKFKGKATLTADKSSSTASMELRLTSEDSAVYFCARRGSGSNYDWYFDVWGQGTTVTVSS  
GGGSGGGGGGGSELMVTQTPLSLPVSLGDQASISCRSSQSLVHSNGNTYLHWYLOKPGQSPKLLIYKVSNR  
FSGVPDRFSGSGGTDFTLKISRVEAEDLGVYFCSSQSTHVPYTFGGGTKLEIKHHHHH



Figure 1

O) anti-CD3 VHVL aL x 4-1 VHVL (SEQ ID NO: 55)

GATATCAAACCTGCAGCAGTCAGGGGCTGAACCTGGGACCTCAGTGAAGATGTCTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGTAAACAGAGGCTGGACAGGCTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGTTATACTAATTACAATCAGAAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTTACTGCTTGACTACTGGGCCAAGCACCTCTCACAGTCTCCTCAGTCGAAGGTGGAA  
GTGGAGGTTCTGGTGGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCACTCTCCAGGGAGAAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAACTGGTACCA  
GCAGAAAGTCAGGCACCTCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCCTTATCGCT  
TCAGTGGCAGTGGGTCCTGGACCTCATACTCTCACAAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGAGCTGGTAAGGCTGGGACTTCAGTGAAGATATCCT  
GCAAGGCTTCTGGATACGCCCTTCACTAACTACTGGCTAGGTTGGGTTAAGCAGAGGCCCTGGACATGGACTTGAA  
TGGGTTGGAGATATTTCCCTGGAAAGTGGTAATGCTCACTACAATGAGAAGTTCAAGGGCAAGCCACACTGAC  
TGCAGACAAGTCCCTCGTACACAGCCTATATGCAGCTCAGTAGCCTGACATCTGAGGACTCTGCTGTCTATTCT  
GTGCAAGATTGCGGAACCTGGGACGAGGCTATGGACTACTGGGCCAAGGACCCAGGTCAACGCTCCTCAGGT  
GGTGGTGGTCTGGCGGGCGGCTCCGGTGGTGGTCTGAGCTCGTGATGACACAGTCTCCATCCTCCCT  
GAGTGTGCAGCAGGAGAGAAGGTCACTATGAGCTGCAAGTCCAGTCAGAGTCTGTTAAACAGTGGAATCAAA  
AGAACTACTTGGCCTGGTACCAGCAAGAAACCAGGGCAGCCTCCTAAACTGTTGATCTACGGGCAATCCACTAGG  
GAATCTGGGGTCCCTGATCGCTTACAGGCAGTGGATCTGGAACAGATTTCACTC

## Figure 1 O) continued

TCACCATCAGCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTCAGAAATGATTATAGTTATCCGTACACG  
TTCGAGGGGGACCAAGCTTGAGATCAAAACATCATCACCATCATCATTAG

(SEQ ID NO: 56)

DIKLQQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQFKDKATLTTDK  
SSSTAYMQLSSLTSEDSAVYYCARYYDDHYCLDYWGQGTTLTVSSVEGGSGGSGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSGTSYSLTSSMEAEADAATY  
YCQQWSSNPLTFGAGTKLELKSGGGSEVQLLEQSGAELVRPGTSVKISCKASGYAFNYYWLVKQRPQGHGLE  
WVGDIFFPGSGNAHYNEKFKGKATLTADKSSYTAQMQLSSLTSEDSAVYFCARLRNWDAMDYWGQGTTVTVSSG  
GGSGGGSGGGSELVMTQSPSSLVSASAGEKVTMSCKSSQSLNSGNQKNYLAWYQQKPGQPPKLLIYGASTR  
ESGVPRDFTGSGSGTDFTLTISSVQAEIDLAVYYCQNDYSYPYTFGGGGTKLEIKHHHHHH

Figure 1

P) anti-CD3 VHVL aL Ser x 4-1 VHVL (SEQ ID NO: 57)

GATATCAAACCTGCAGCAGTCAGGGCTGAACTGGCAAGACCCTGGGCCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACACAGAGGCCCTGGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGGTTATACTAATTACAATCAGAAGTTCAGGACAAGGCCACATTGACTACAGACAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATTAATTAATTAATTAATTAATTAATTAATTAATTAATTAATTAATTAATTAATTAAT  
GTGGAGGTTCTGGTGAAGTGGAGGTTCAAGTGGAGTCGACGACATTCAGCTGACCCAGTCTCCAGCAATCATG  
TCTGCACTCCAGGGGAGAAGTCAACCATGACCTGCAGAGCCAGTTCAAGTGTAAAGTTACATGAAGTGGTACCA  
GCAGAAGTCAGGCACCTCCCCAAAGATGGATTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCT  
TCAGTGGCAGTGGGTTCTGGACCTCATACTCTCAACAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTAT  
TACTGCCAACAGTGGAGTAGTAACCCGCTCACGTTCCGGTGGTGGACCAAGCTGGAGCTGAAATCCGGAGGTGG  
TGGATCCGAGGTGCAGCTGCTCGAGCAGTCTGGAGCTGGTAAAGGCTGGAGCTTCAGTGAAGATATCCT  
GCAAGGCTTCTGGATACGCCCTTCACTAACTACTGGCTAGGTTGGTTAAGCAGAGGCCCTGGACATGGACTTGAA  
TGGGTTGGAGATATTTCCCTGGAAGTGGTAATGCTCACTACAATGAGAAGTTCAAGGCCAAAGCCACACTGAC  
TGCAGACAAGTCCCTCGTACACAGCCTATATGCAGCTCAGTAGCCTGACATCTGAGGACTCTGCTGTATTCT  
GTGCAAGATTGCCGAACCTGGACGAGGCTATGGACTACTGGGCCAAAGGCCACCGTCAACCGTCTCCTCAGGT  
GGTGGTGGTCTGGCGCGCGGCTCCGGTGGTGGTGGTGGTGGTGGTGGTGGTGGTGGTGGTGGTGGTGGTGGT  
GAGTGTGTGAGCAGGAGAGAAGGTCACTATGAGCTGCAAGTCCAGTCAGAGTCTGTTAAACAGTGGAAATCAAA  
AGAACTACTTGGCCTGGTACCAGCAGAAACCAGGGCAGCCTCCTAAACTGTTGATCTACGGGGCATCCACTAGG  
GAATCTGGGGTCCCTGATCGCTTCACAGGCAGTGGATCTGGAACAGATTTCACCTC

## Figure 1 P) continued

TCACCATCAGCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTCAAGATGATTATAGTTATCCGTACACG  
TTCCGAGGGGACCAAGCTTGAGATCAAACATCATCACCATCATCATTAG

## (SEQ ID NO: 58)

DIKLQSGAELARPGASVKMSCKTSGYTFTRYTMHWVKQRPQGQLEWIGYINPSRGYTNYNQFKDKATLTTDK  
SSSTAYMQLSLTSSEDSAVYYCARYDDHYSLDYWGQGTTLTVSSVEGGSGGGVDDIQLTQSPAIM  
SASPGEKVTMTCRASSVSVMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGGTSYSLTSSMEAEDAATY  
YCQQWSSNPLTFGAGTKLELKS GGGSEVQLLEQSGAELVRPGTSVKISCKASGYAFITNYWLGWVKQRPQGHGLE  
WVGDI FPGSGNAHYNEKFKGKATLTADKSSYTA YMQLSLTSSEDSAVYFCARLRNWD EAMDYWGQGTITVTVSSG  
GGSGGGGGGSELVMTQSPSSLSVSAGEKVTMSCKSSQSLNSGNQKNYLAWYQQKPGQPPKLLIYGASTR  
ESGVPDRFTGSGSGTDFLTITSSVQAEDLAVYYCQNDYSYPYTFGGGTKLEIKHHHHHH



## Figure 1

## Q) anti-CD3 VHVL stL x 4-1 VHVL (SEQ ID NO: 59)

GATATCAAACTGCAGAGTCAGGGCTGAACTGGCAAGACCTGGGGCCTCAGTGAAGATGTCTGCAAGACTTC  
TGGCTACACCTTTACTAGGTACACGATGCACCTGGGTAAACACAGAGGCTTGACAGGGTCTGGAATGGATTGGAT  
ACATTAAATCCTAGCCGTGGTTATACTAATTACAATCAGAAGTTCAAGGACAAGGCCACATTGACTACAGACAAA  
TCCTCCAGCACAGCCTACATGCAACTGAGCAGCCTGACATCTGAGGACTCTGCAGTCTATTACTGTGCAAGATA  
TTATGATGATCATTAATGCTTACTACTGGGCAAGGCACCTCTCACAGTCTCCTCAGGTGGTGGTT  
CTGGCGGCGGCTCCGGTGGTGGTTCTGACATTCAGCTGACCCAGTCTCCAGCAATCATGTCTGCATCT  
CCAGGGAGAAGGTCACCATGACCTGCAGAGCCAGTTCAAAGTGAAGTTACATGAAGTGGTACCCAGCAAGATC  
AGGCACCTCCCCAAAGATGGATTTATGACACATCCAAAGTGGCTTCTGGAGTCCCTTATCGCTTCAGTGGCA  
GTGGTCTGGGACCTCATACTCTCTCACAATCAGCAGCATGGAGGCTGAAGATGCTGCCACTTATTACTGCCAA  
CAGTGGAGTAGTAACCCGCTCACGTTCCGGTCTGGGACCAAGCTGGAGCTGAAATCCGGAGGTGGTGGATCCGA  
GGTGAGCTGCTCGAGCAGTCTGGAGCTGGTAAGGCTGGGACTTCAGTGAAGATATCCTGCAAGGCTT  
CTGGATACGCCCTTCACATACTACTGGCTAGGTTGGTTAAGCAGAGGCCCTGGACATGGACTTGAATGGGTTGGA  
GATAATTTCCCTGGAAGTGGTAATGCTCACTACAATGAGAAGTTCAGGGCAAGCCACACTGACTGCAGACAA  
GTCTCTGTACACAGCCTATATGCAGCTCAGTAGCCTGACATCTGAGGACTCTGCTGTCTATTCTGTGCAAGAT  
TGCGGAACCTGGGACGAGGCTATGGACTACTGGGCCAAGGGACCCAGGTCAACCTCAGGTGGTGGTGGT  
TCTGGCGGCGGCTCCGGTGGTGGTCTGAGCTCGTGATGACACAGTCTCCATCCTCCCTGAGTGTGTC  
AGCAGGAGAGAAGGTCACTATGAGCTGCAAGTCCAGTCAGAGTCTGTTAAACAGTGGAAATCAAAAGAACTACT  
TGGCCTGGTACCAGCAGAAACCAGGGCAGCCTCCTAAACTGTGATCTACGGGGCATCCACTAGGGAATCTGGG  
GTCCCTGATCGCTTCACAGGCAGTGGATCTGGAACAGATTTCACTCTCACCATCA



Figure 1 Q) continued

GCAGTGTGCAGGCTGAAGACCTGGCAGTTTATTACTGTCAAGATGATTATAGTTATCCGTACACGTTCCGGAGGG  
GGGACCAAGCTTGAGATCAAAACATCATCACCATCATCATTAG

(SEQ ID NO: 60)

DIKLOQSGAELARPGASVKMSCKTSGYTFTRYTMHVVKQRPQGQLEWIGYINPSRGYTNYNQFKDKATLTDDK  
SSSTAYMQLSSLTSEDSAVYYCARYDDHYCLDYWGQGTTLTVSSGGGGGGGGSDIQLTQSPAIMAS  
PGEKVTMTCRASSSVSYMNWYQQKSGTSPKRWIYDTSKVASGVPYRFSGSGSTSYSLTSSMEAEADAATYYCQ  
QWSSNPLTFGAGTKLELKSGGGGSEVQLLEQSGAELVRPGTSVKISCKASGYAFITNYWLGVKQRPFGHGLEWVG  
DIFPGSGNAHYNEKFKGKATLTADKSSYTAYMQLSSLTSEDSAVYFCARLRNWDAMDYWGQGT'TVTVSSGGGG  
SGGGGGGGSELVMTQSPSSLVSAGEKVTMSCKSSQSLNSGNQKNYLAWYQQKPGQPPKLLIYGASTRESG  
VPDRFTGSGSGTDEFTLTISSVQAEDLAVYYCQNDYSYPYTFGGGTKEIKHHHHHH

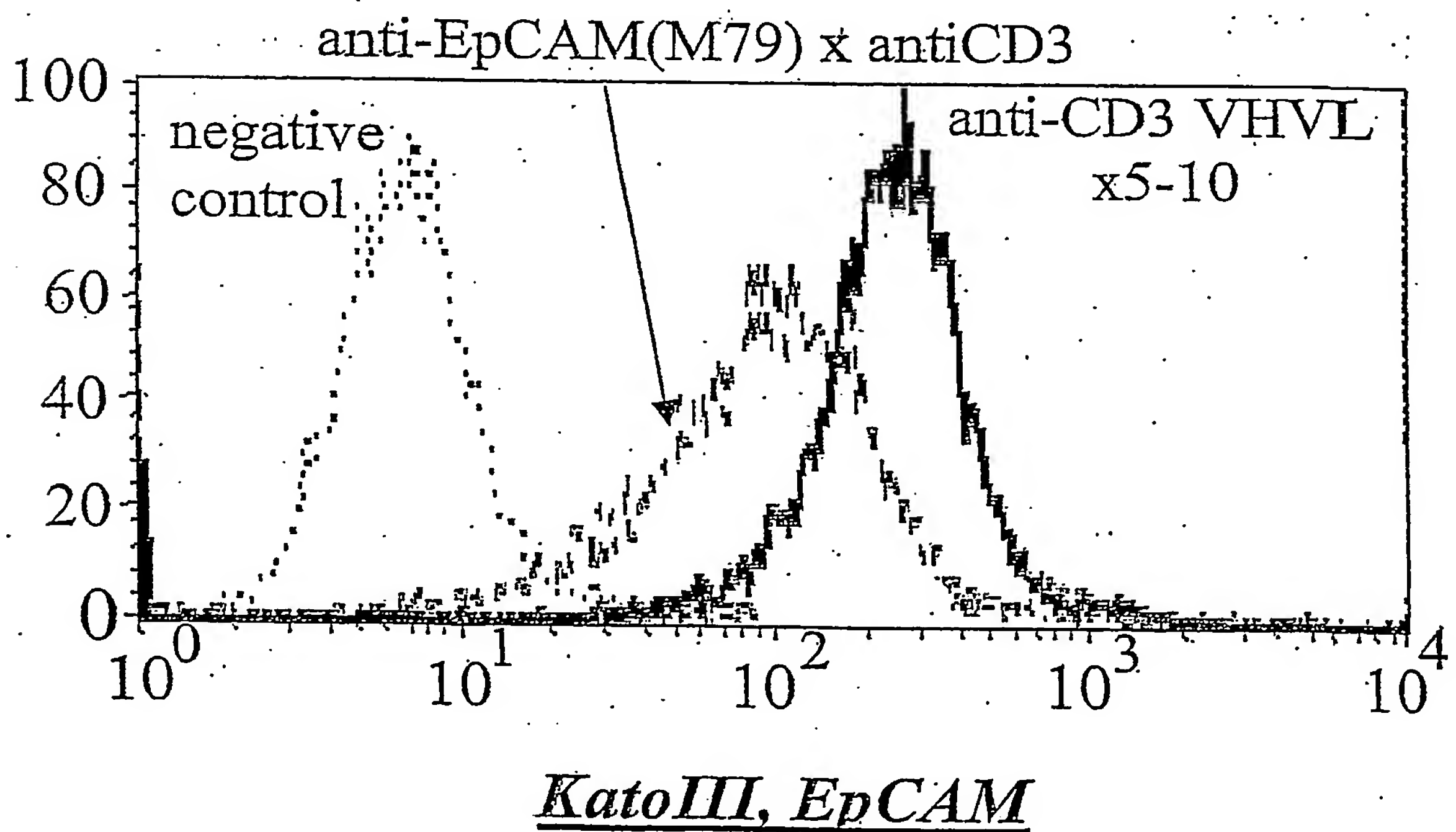
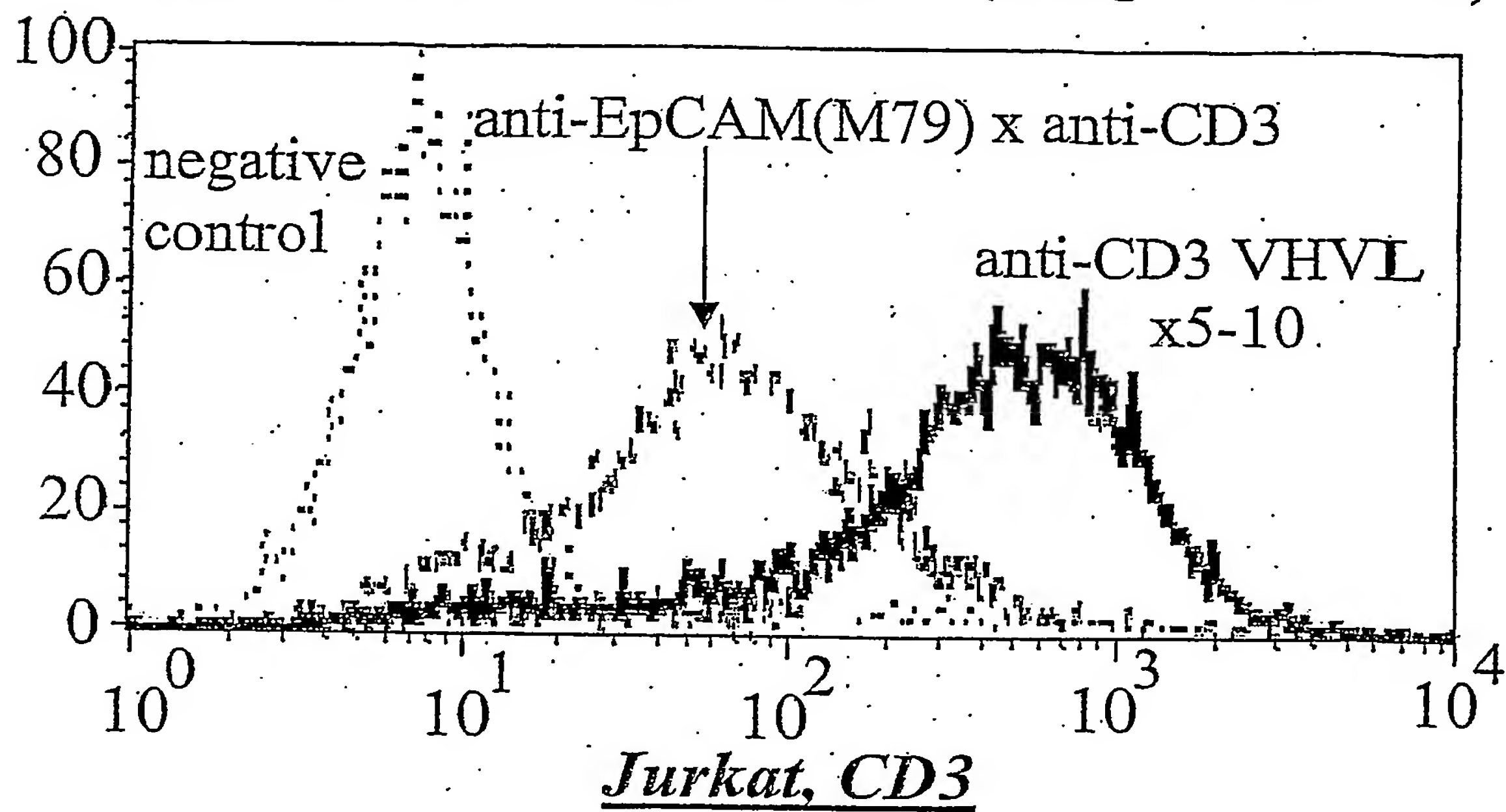
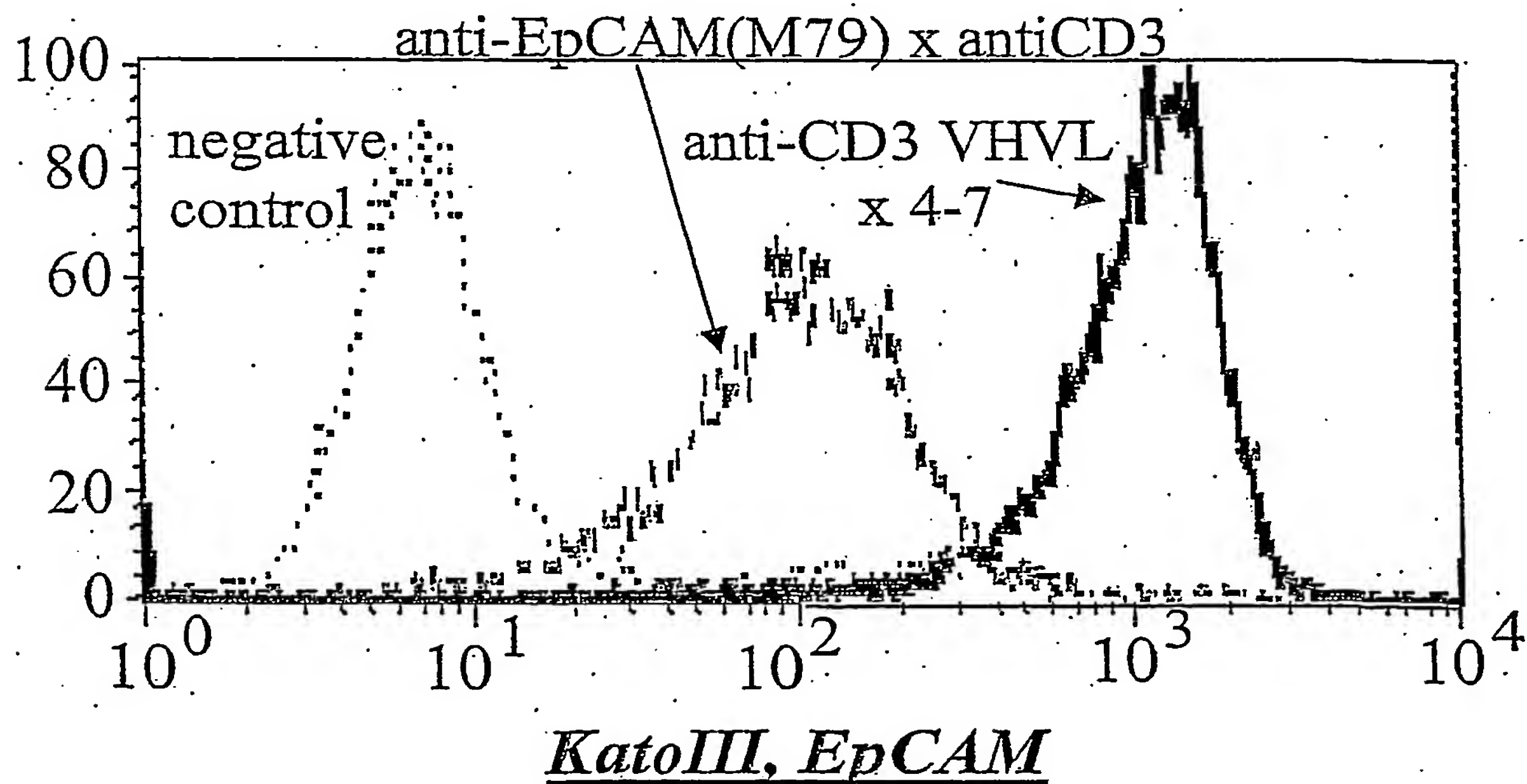
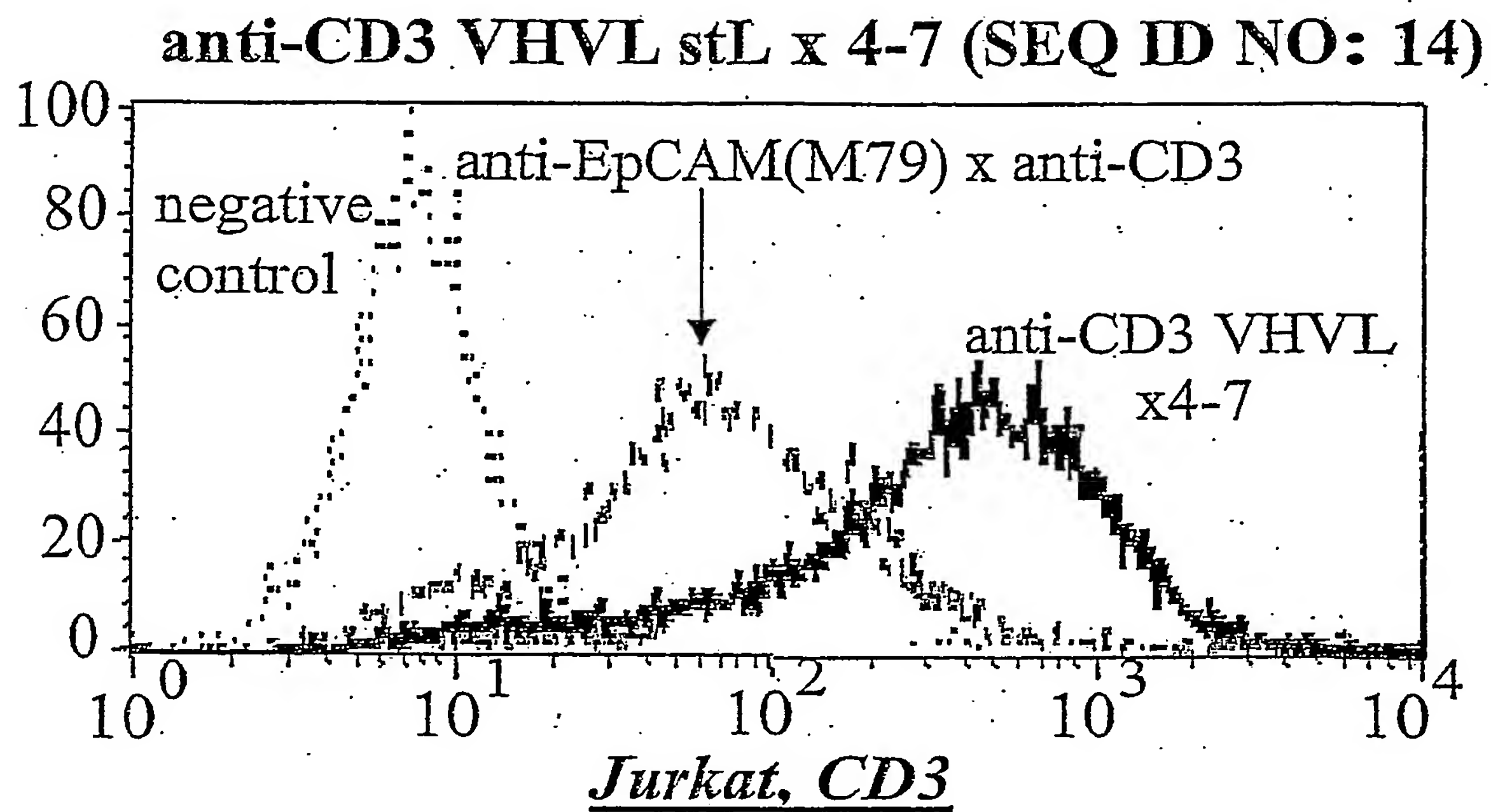
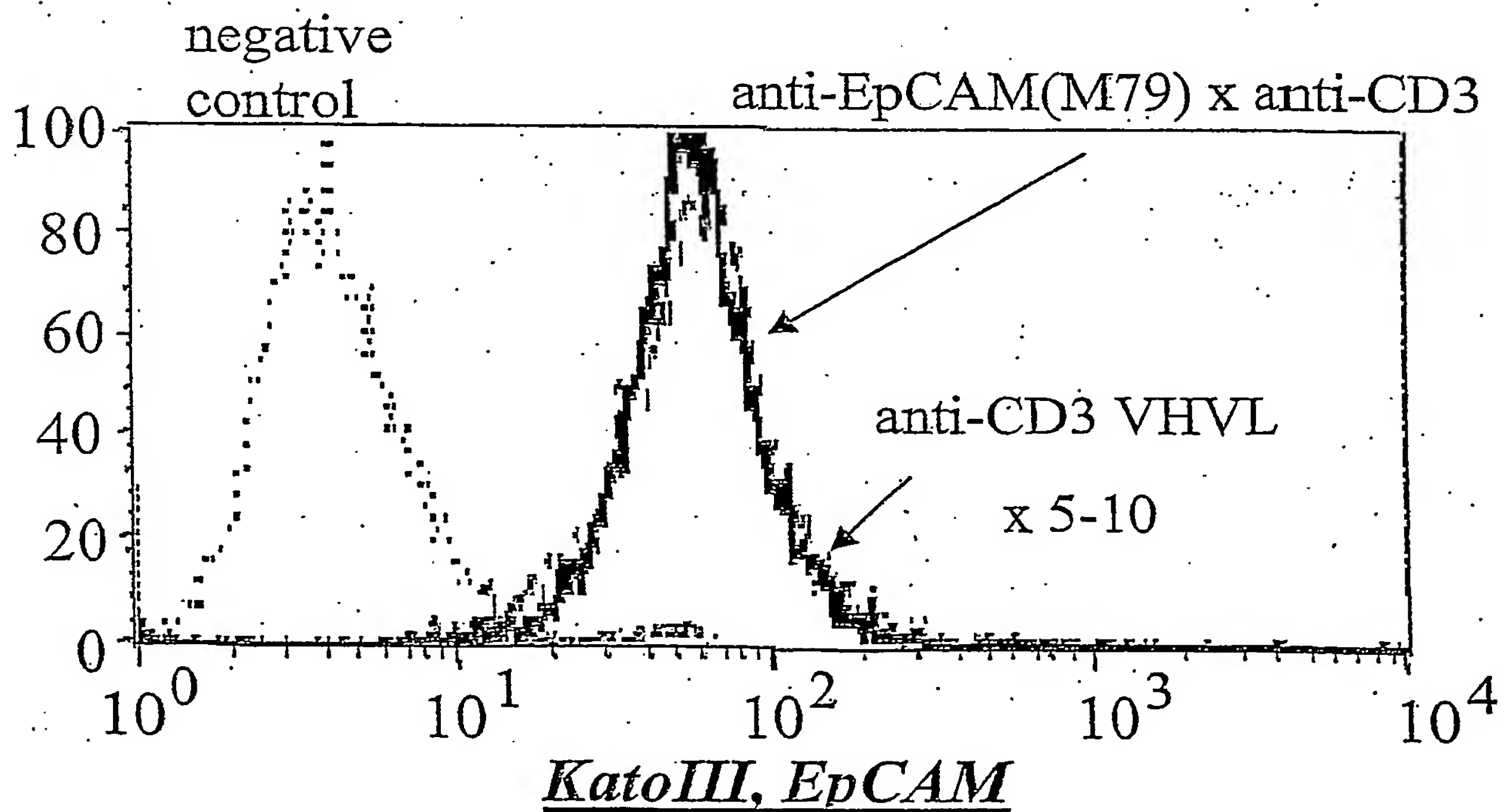
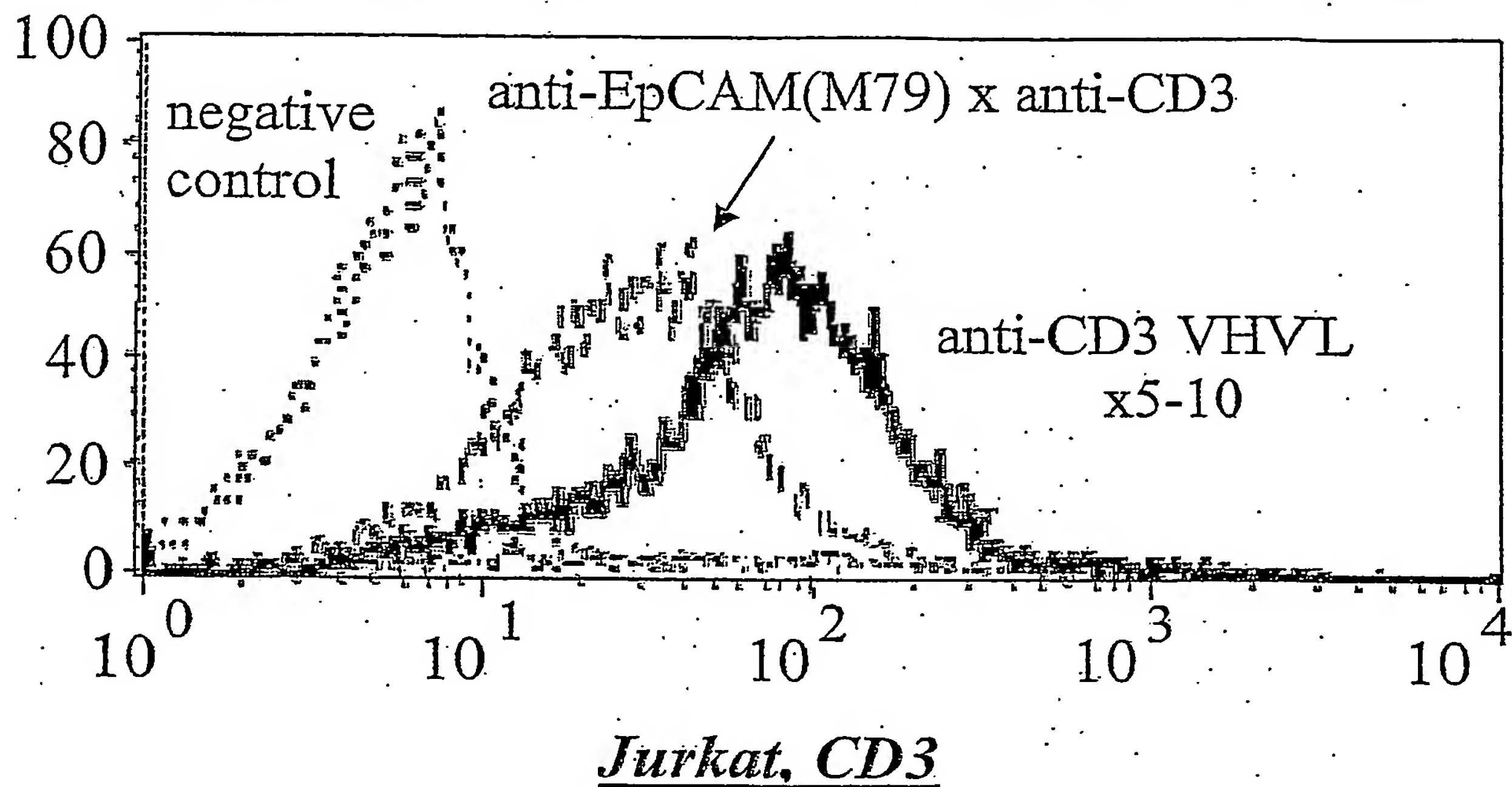
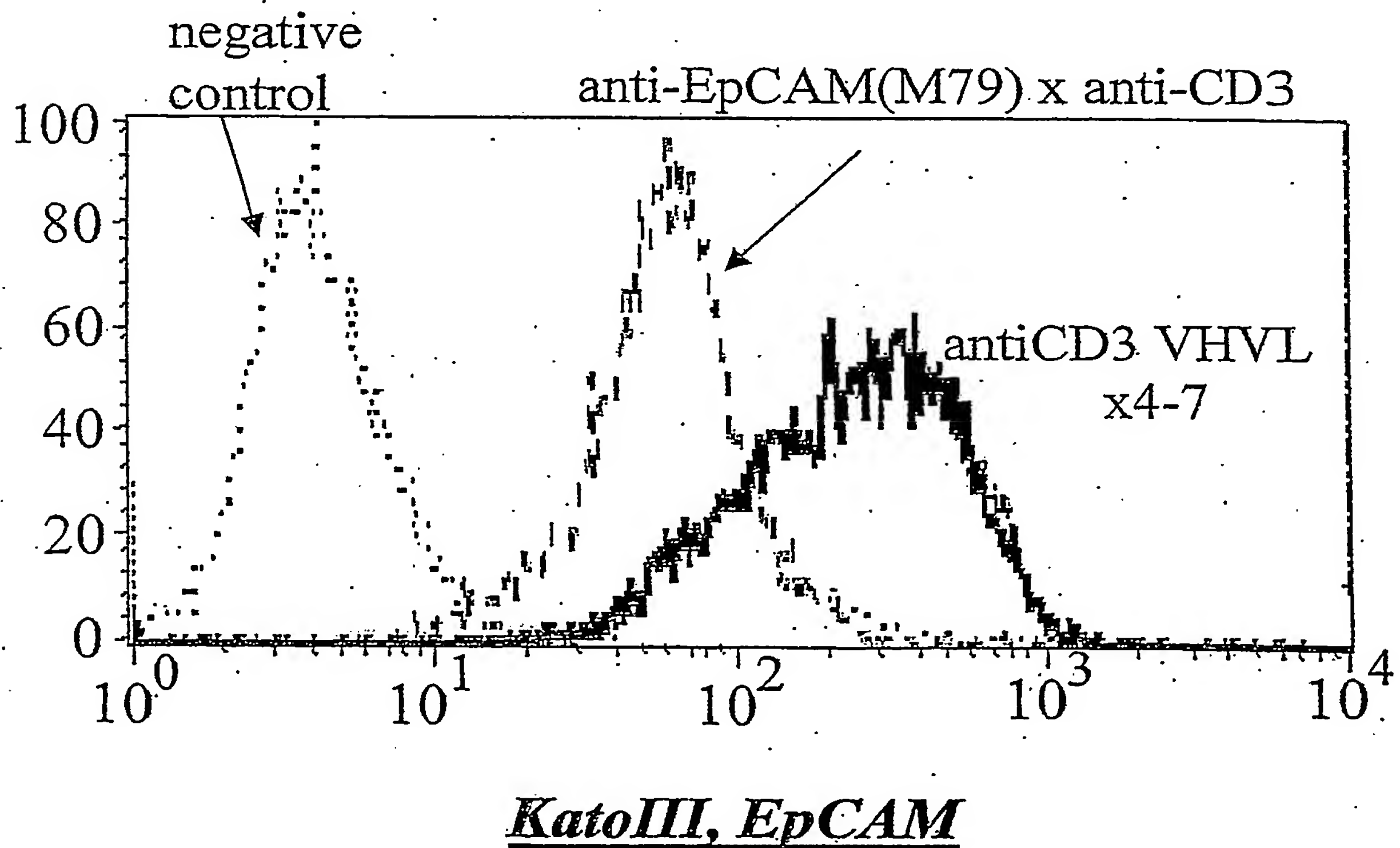
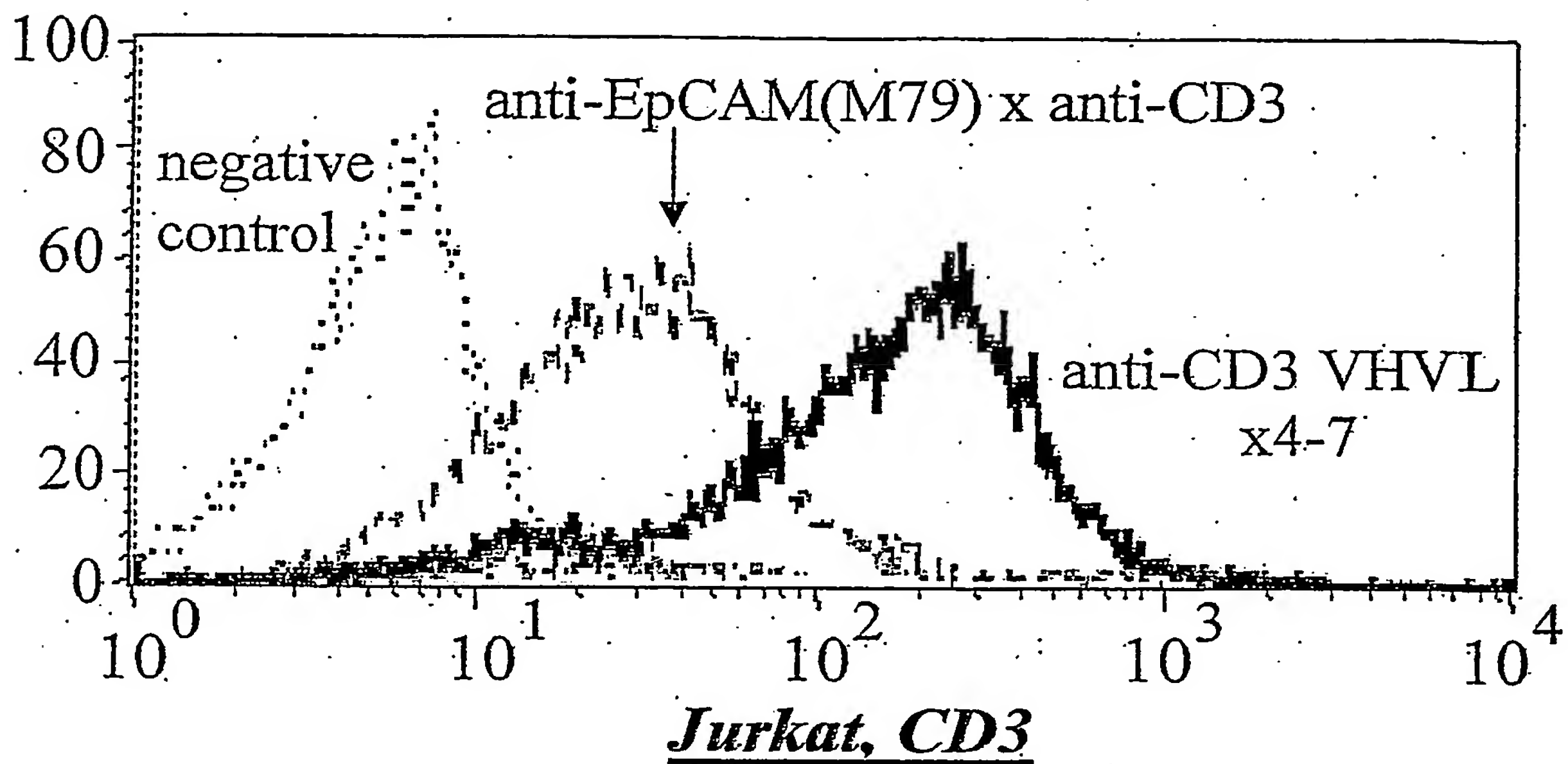
**Figure 2 A****anti-CD3 VHVL stL x 5-10 (SEQ ID NO: 18)**

Figure 2 B



**Figure 2C****anti-CD3 VHVL aL x 5-10 (SEQ ID NO: 4)**

**Figure 2D****anti-CD3 VHVL aL x 4-7 (SEQ ID NO: 2)**



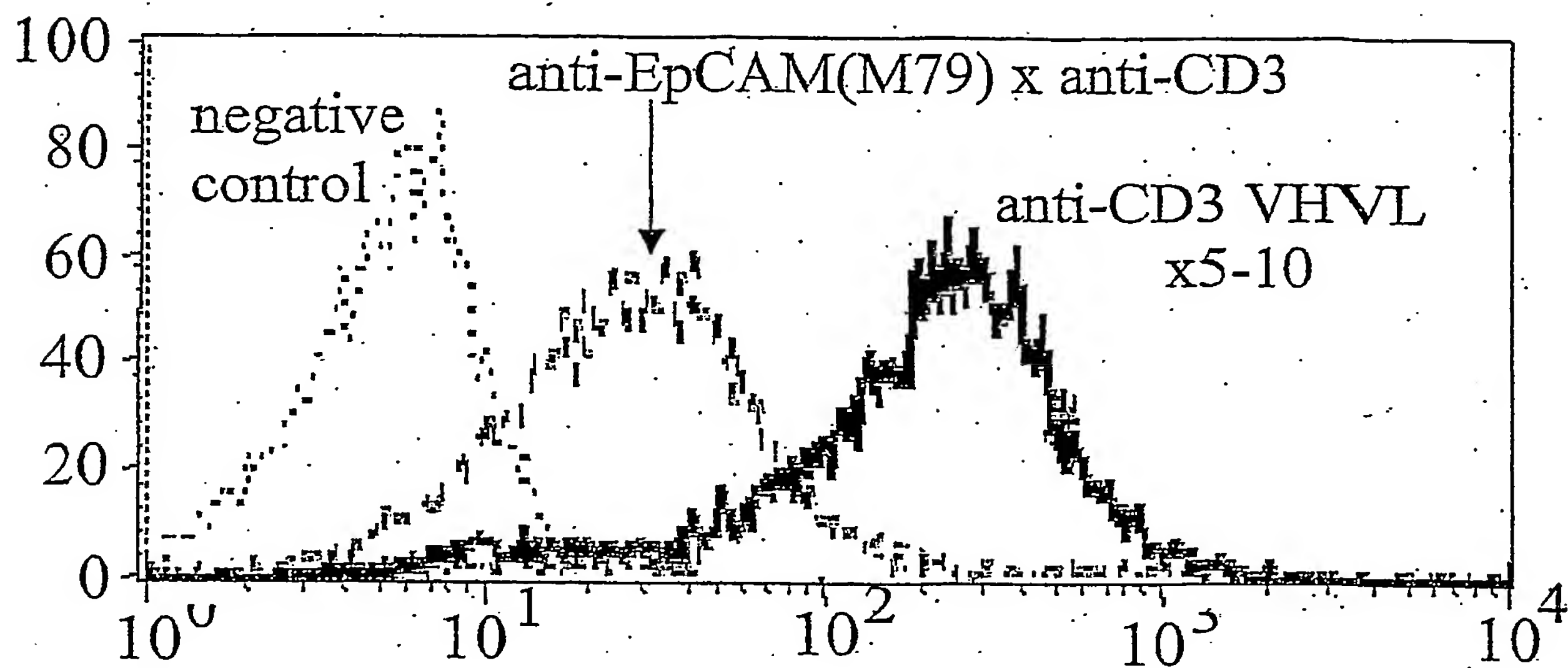
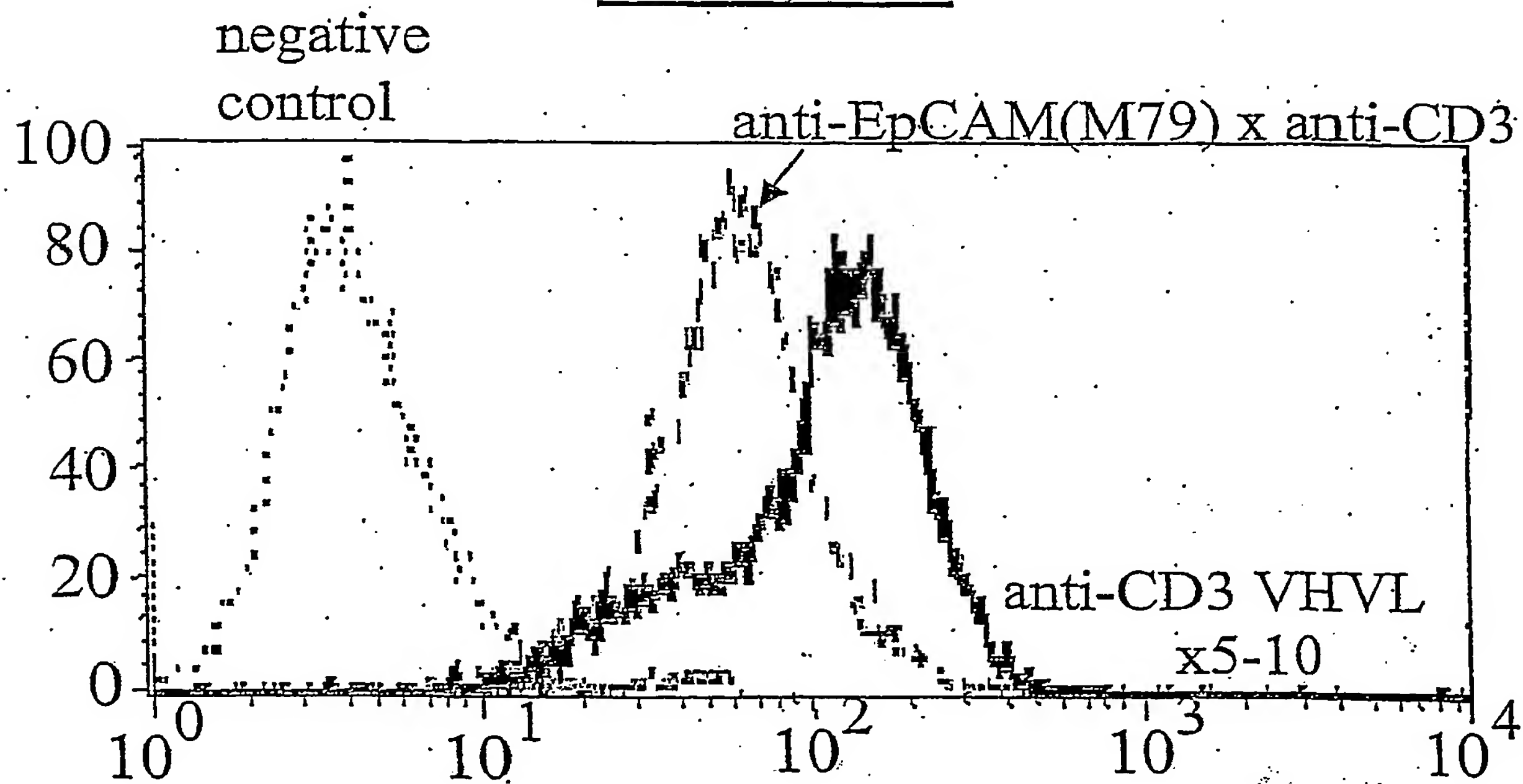
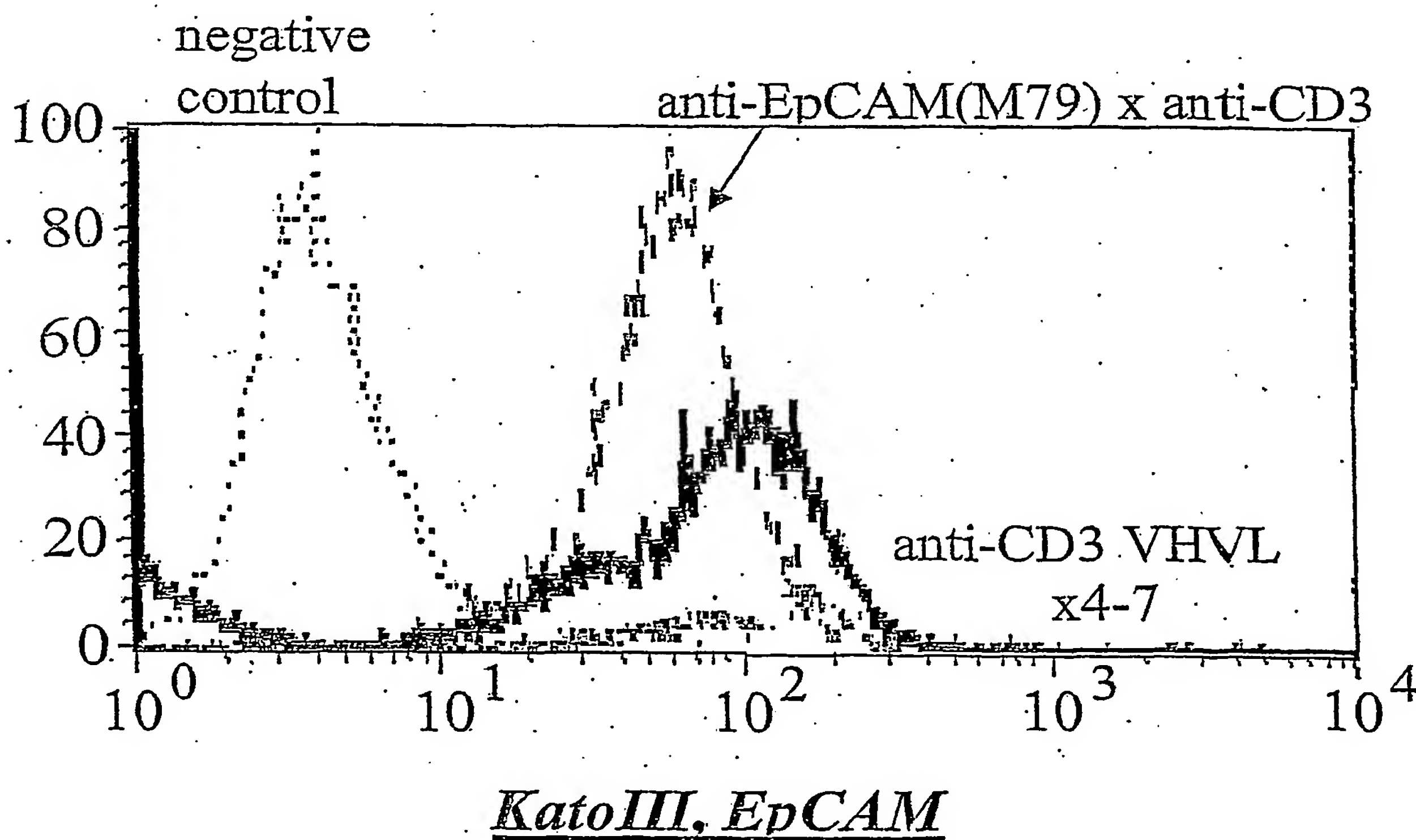
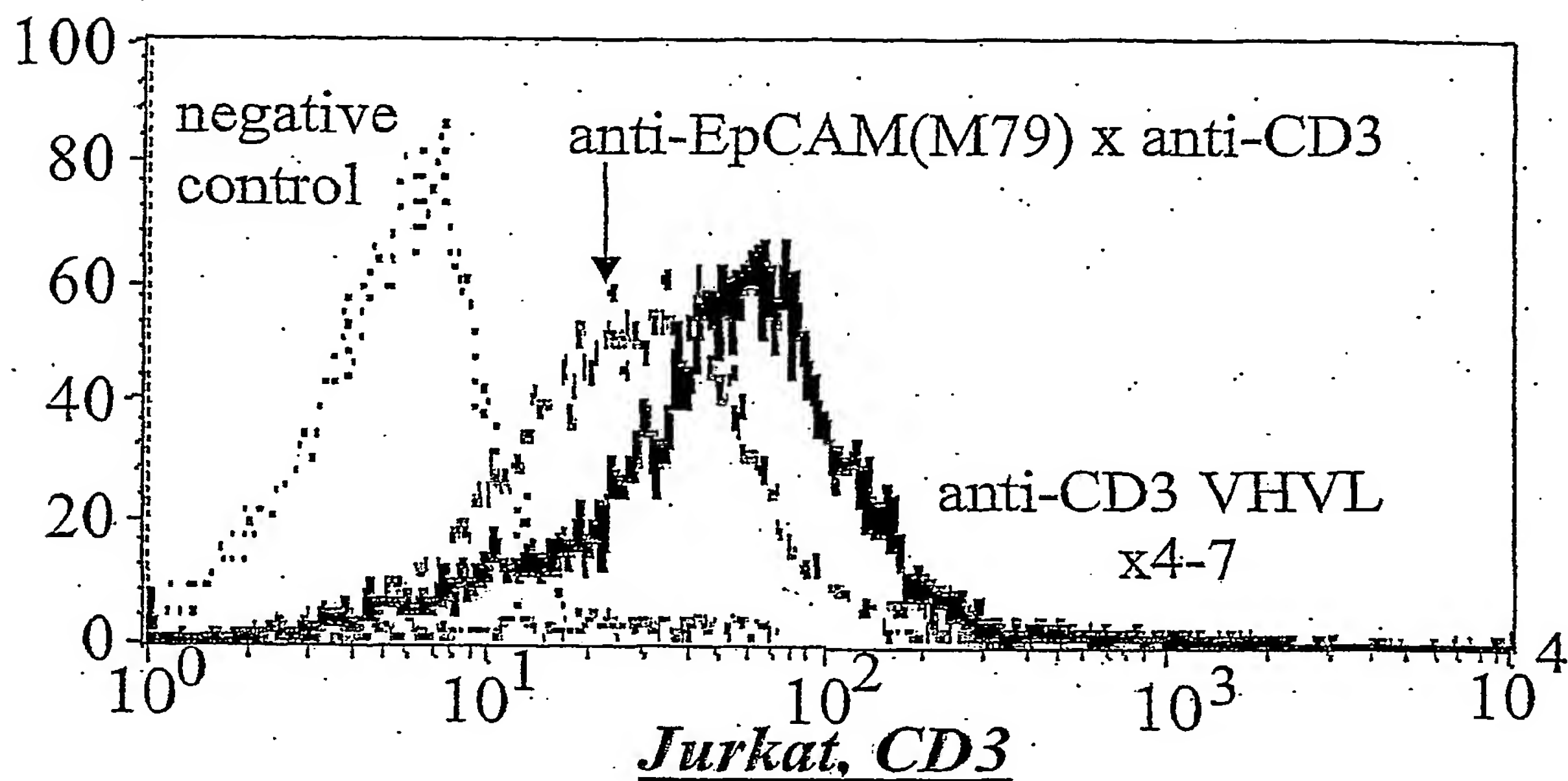
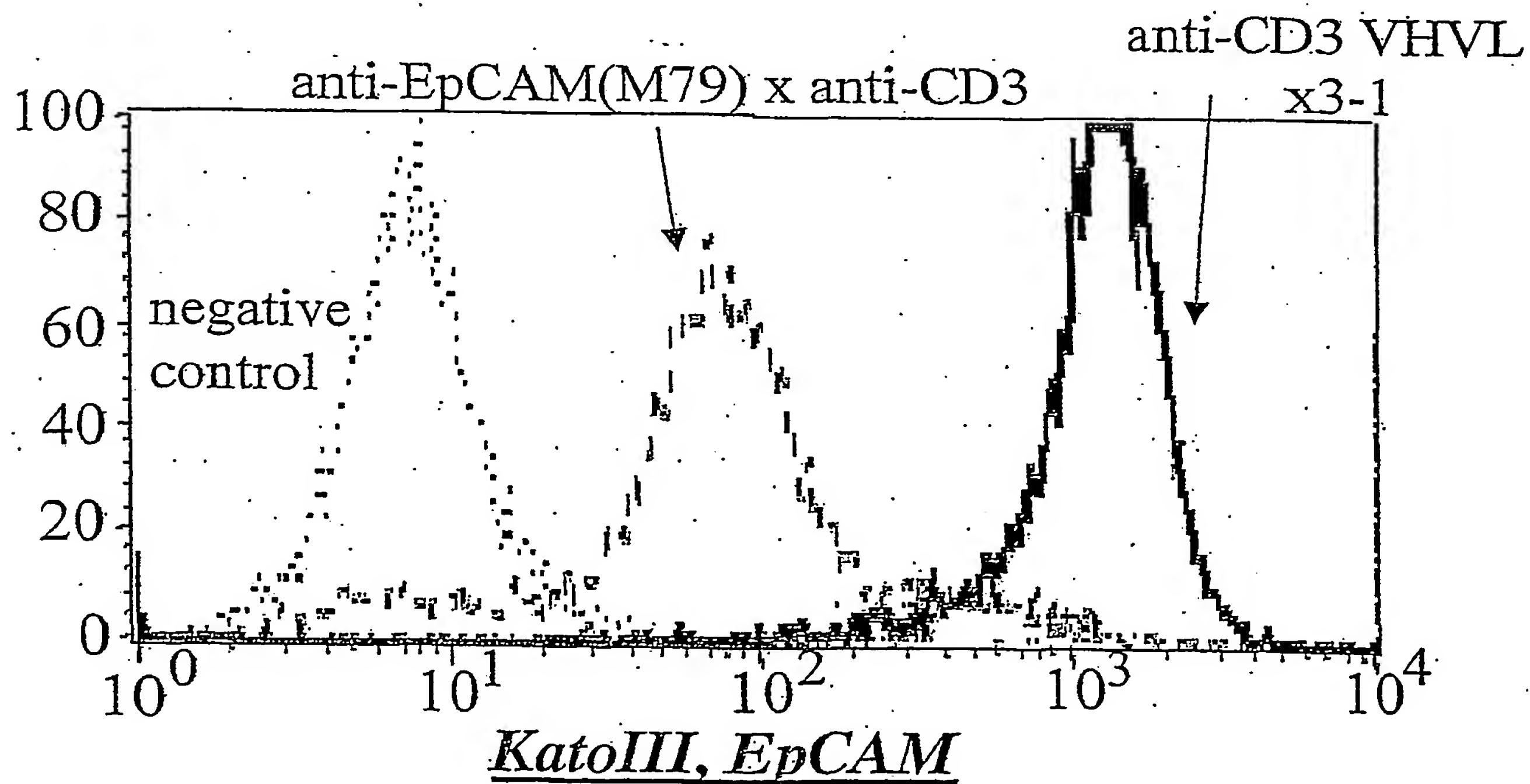
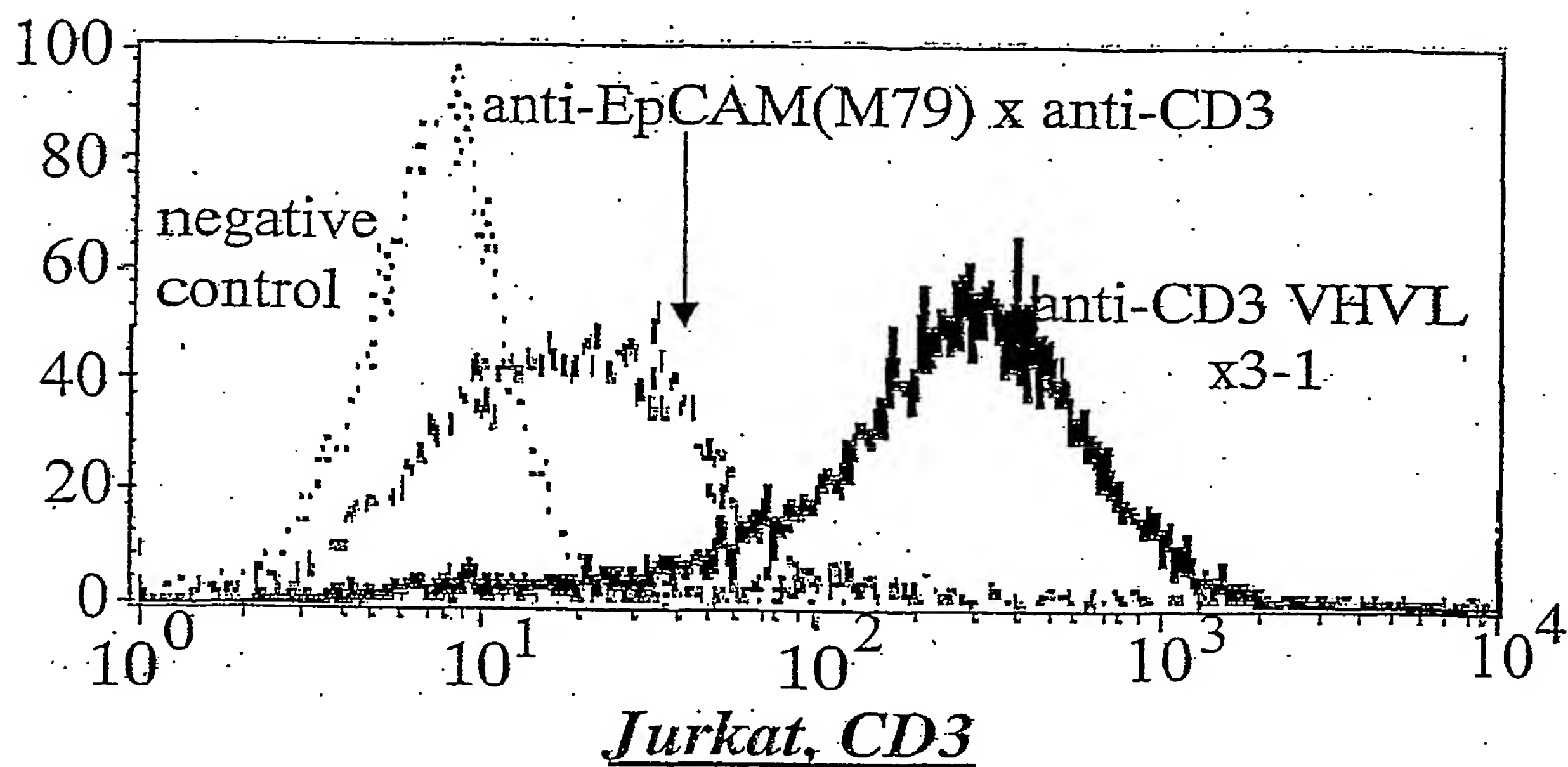
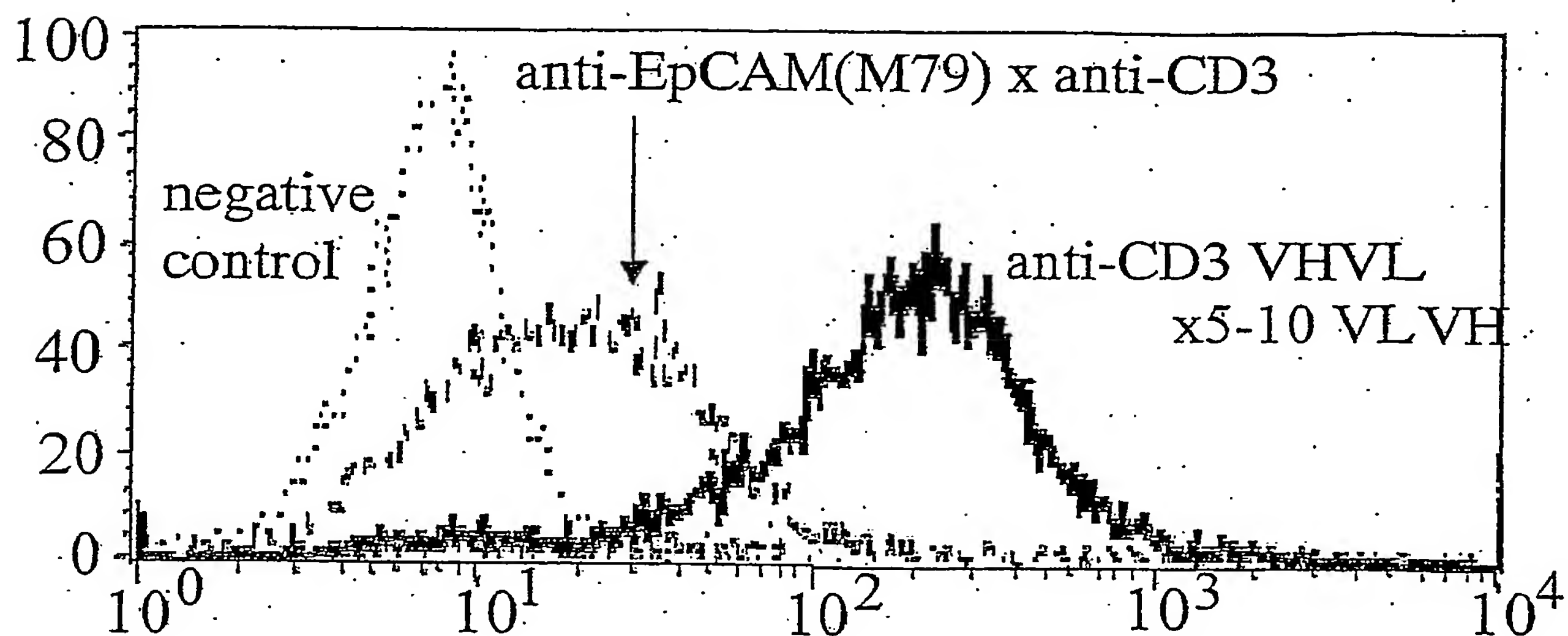
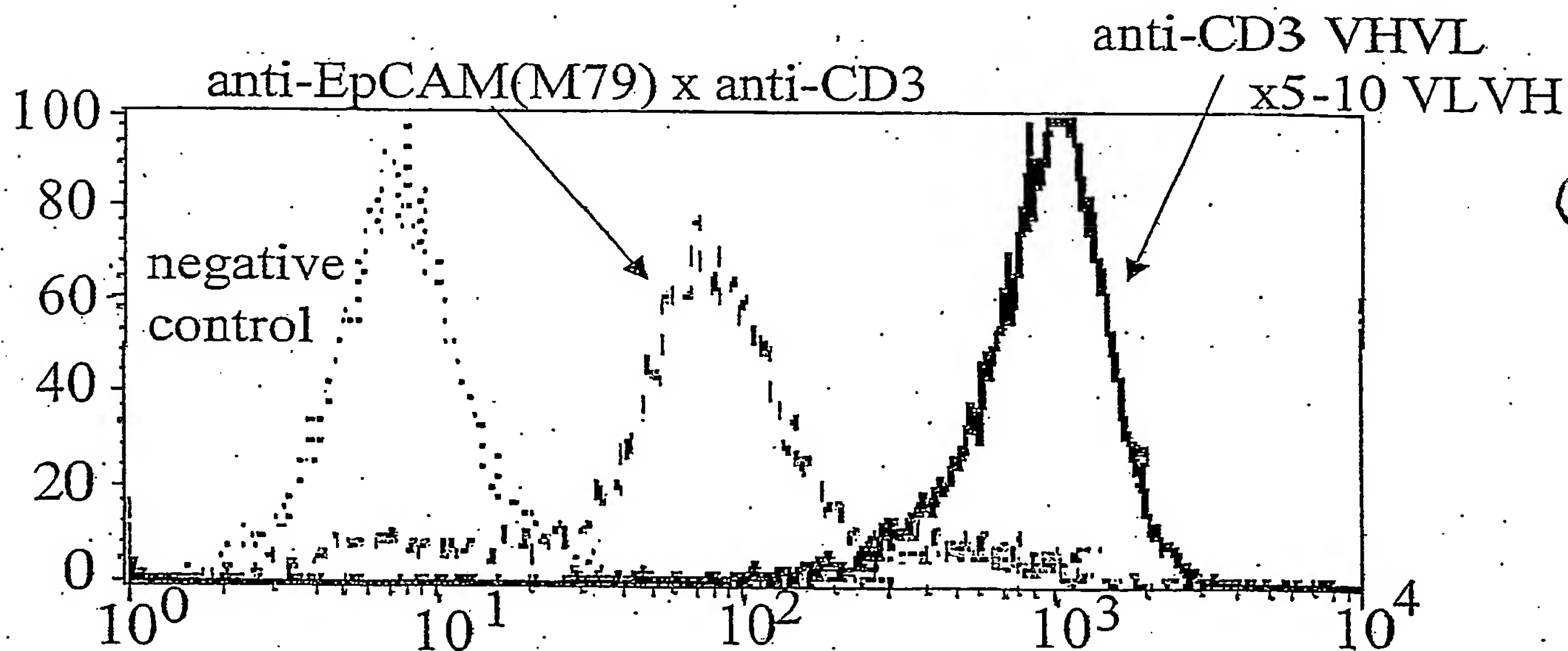
**Figure 2E****anti-CD3 VHVL aL Ser x 5-10 (SEQ ID NO: 10)****Jurkat, CD3****KatoIII, EpCAM**

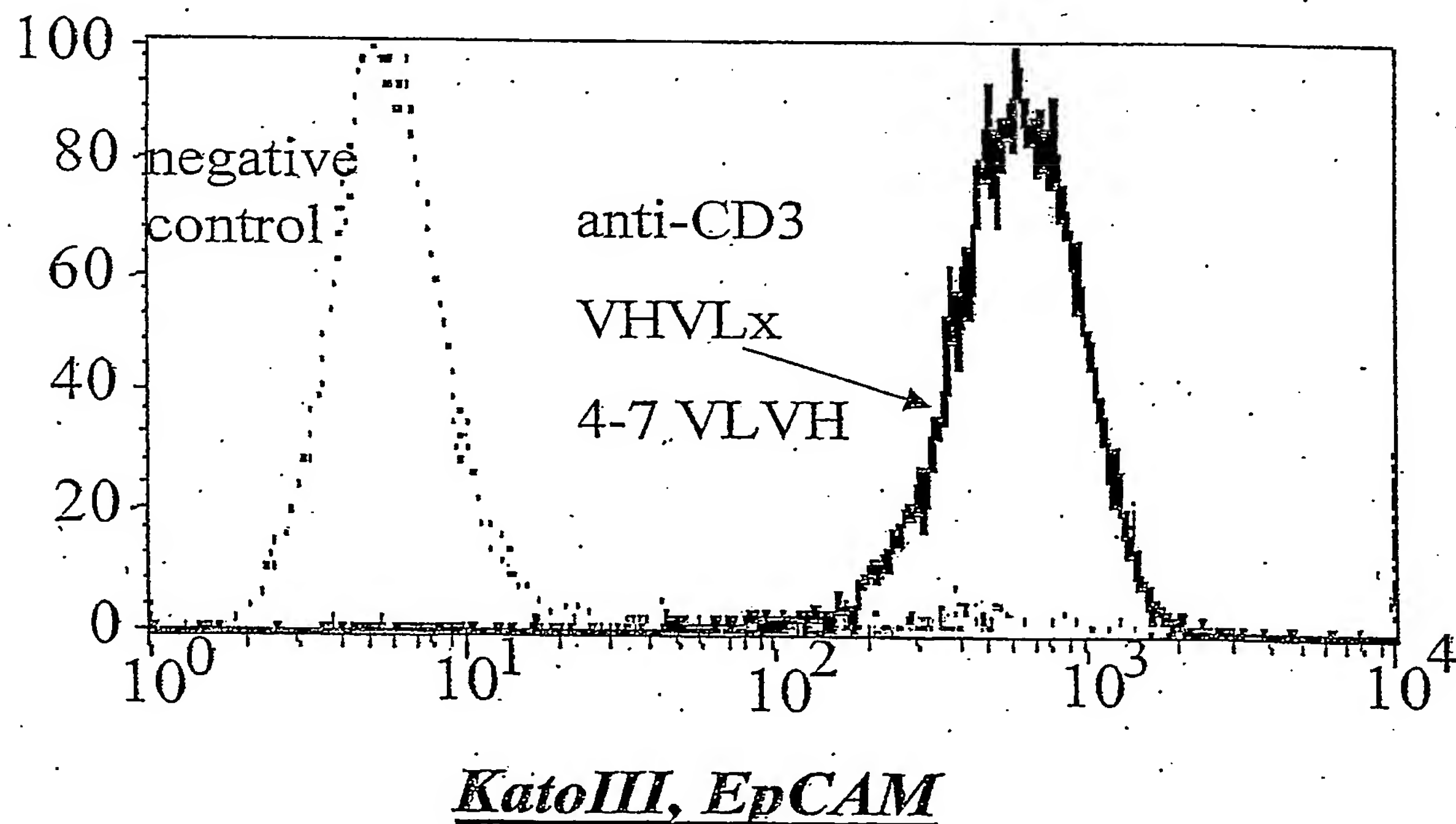
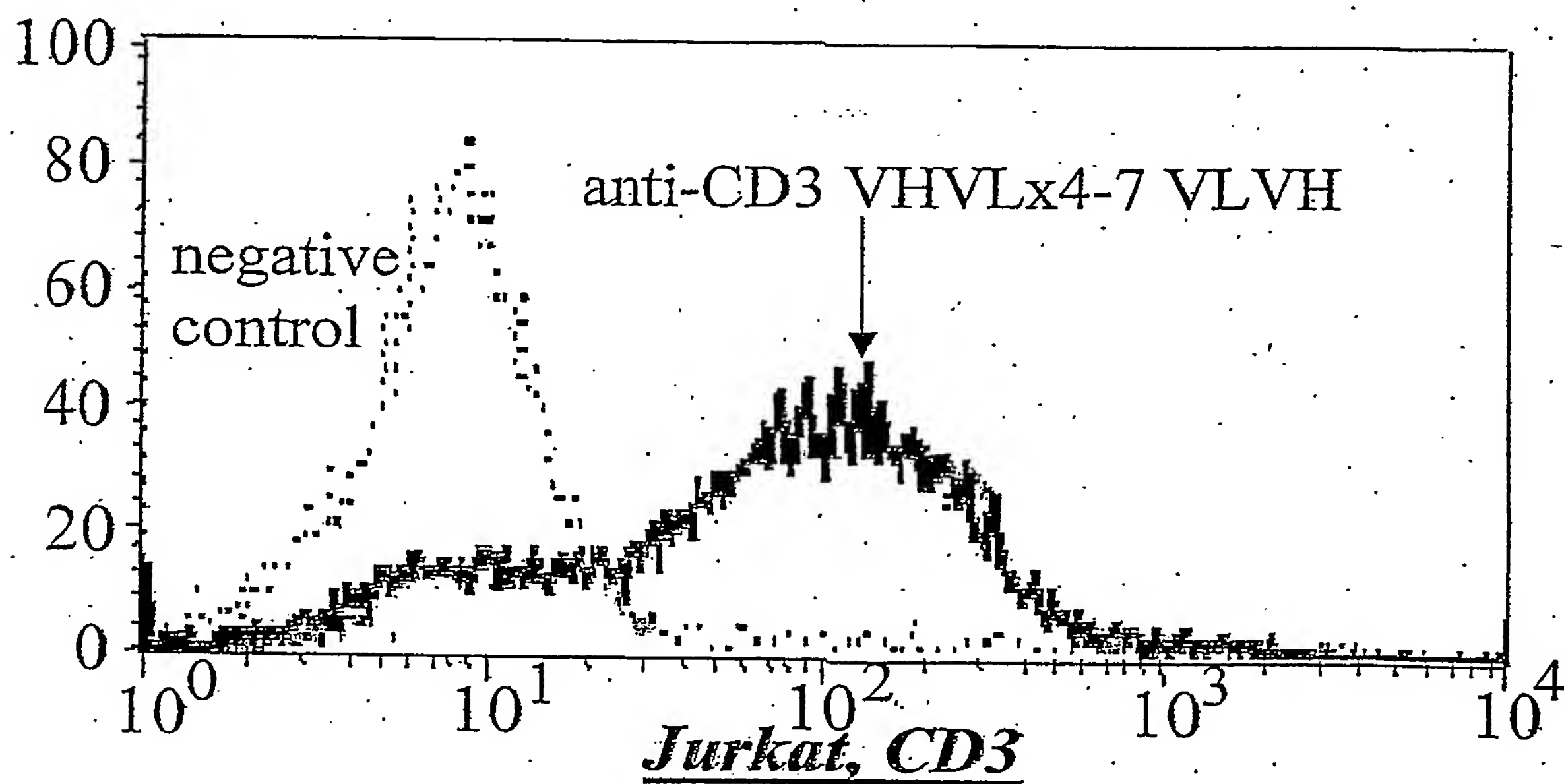
Figure 2F

anti-CD3 VHVL aL Ser x 4-7 (SEQ ID NO: 8)



**Figure 2G****anti-CD3 VHVL stL x 3-1 (SEQ ID NO: 12)**

**Figure 2H****anti-CD3 VHVL stL x 5-10 VLVH (SEQ ID NO: 20)****Jurkat, CD3****KatoIII, EpCAM**

**Figure 2I****anti-CD3 VHVL stL x 4-7 VLVH (SEQ ID NO: 16)**



## Figure 3A

## 4-7 (VLVH) x anti-CD3 (SEQ ID NO: 42)

1 MGWSCIILFL VATATGVHSA RELVMTQTPL SLPVSLGDQA SISCRSSQSL  
51 VHSNGNTYLH WYLQKPGQSP KLLIYKVSNR FSGVPDRFSG SGSCTDFTLK  
101 ISRVEAEDLG VFCSQSTHV PYTFGGGTKL EIKGGGGSGG GSGGGGSEV  
151 QLLEQSGAEL ARPGASVKLS CKASGYTFN YGLSWVKQRP GQVLEWIGEV  
201 YPRIGNAYYN EKFKGKATLT ADKSSSTASM ELRLTSEDS AVYFCARRGS  
251 YDTNYDWYFD VWGQGTTVTV SSGGGGSDIK LQQSGAELAR PGASVKMSCK  
301 TSGYTFTRYT MHWVKQRPQ GLEWIGYINP SRGYTNYNQK FKDKATLTDD  
351 KSSSTAYMQL SSLTSEDSAV YYCARYYDDH YCLDYWGQGT TLTVSSVEGG  
401 SGGSGSGGS GGVDDIQLTQ SPAIMASAPG EKVTMTCRAS SSVSYMNNWYQ  
451 QKSGTSPKRW IYDTSKVASG VPYRFSGSGS GTSYSLTISS MEAEADAATYY  
501 CQQWSSNPLT FGAGTKLELK HHHHHH\*

## Figure 3A (continued)

SEQ ID NO: 41

```
1  ATGGGATGGA  GCTGTATCAT  CCTCTTCTTG  GTAGCAACAG  CTACAGGTGT
51  ACACTCCGCG  CGCGAGCTCG  TGATGACCCA  GACTCCACTC  TCCCTGCCCTG
101 TCAGTCTTGG  AGATCAAGCC  TCCATCTCTT  GCAGATCTAG  TCAGAGCCTT
151 GTACACAGTA  ATGGAACAC  CTATTACAT  TGGTACCTGC  AGAAGCCAGG
201 CCAGTCTCCA  AAGCTCCTGA  TCTACAAAGT  TTCCAACCGA  TTTTCTGGGG
251 TCCCAGACAG  GTTCAGTGGC  AGTGGATCAG  GGACAGATTT  CACACTCAAG
301 ATCAGCAGAG  TGGAGGCTGA  GGATCTGGGA  GTTTATTCT  GCTCTCAAAG
351 TACACATGTT  CCGTACACGT  TCGGAGGGGG  GACCAAGCTT  GAGATCAAAG
401 GTGGTGGTGG  TTCTGGCGGC  GGCGGCTCCG  GTGGTGGTGG  TTCTGAGGTG
451 CAGCTGCTCG  AGCAGTCTGG  AGCTGAGCTG  GCGAGGCCCTG  GGGCTTCAGT
501 GAAGCTGTCC  TGCAAGGCTT  CTGGCTACAC  CTTCACAAAC  TATGGTTTAA
551 GCTGGGTGAA  GCAGAGGCCT  GGACAGGTCC  TTGAGTGGAT  TGGAGAGGTT
601 TATCCTAGAA  TTGGTAATGC  TTACTACAAT  GAGAAATTCA  AGGCAAGGC
651 CACACTGACT  GCAGACAAAT  CCTCCAGCAC  AGCGTCCATG  GAGCTCCGCA
701 GCCTGACCTC  TGAGGACTCT  GCGGTCTATT  TCTGTGCAAG  ACGGGATCC
751 TACGATACTA  ACTACGACTG  GTACTTCGAT  GTCTGGGGCC  AAGGGACCAC
801 GGTCACCGTC  TCCTCCGGAG  GTGGTGGATC  CGATATCAAA  CTGCAGCAGT
851 CAGGGGCTGA  ACTGGCAAGA  CCTGGGGCCT  CAGTGAAGAT  GTCCTGCAAG
```

## Figure 3A (continued)

901 ACTTCTGGCT ACACCTTTAC TAGGTACACG ATGCACTGGG TAAAACAGAG  
951 GCCTGGACAG GGTCTGGAAT GGATTGGATA CATTAATCCT AGCCGTGGTT  
1001 ATACTAATTA CAATCAGAAG TTCAAGGACA AGGCCACATT GACTACAGAC  
1051 AAATCCTCCA GCACAGCCTA CATGCAACTG AGCAGCCTGA CATCTGAGGA  
1101 CTCTGCAGTC TATTACTGTG CAAGATATTA TGATGATCAT TACTGCCTTG  
1151 ACTACTGGGG CCAAGGCACC ACTCTCACAG TCTCCTCAGT CGAAGGTGGA  
1201 AGTGGAGGTT CTGGTGGAAG TGGAGGTTCA GGTGGAGTCG ACGACATTCA  
1251 GCTGACCCAG TCTCCAGCAA TCATGTCTGC ATCTCCAGGG GAGAAGGTCA  
1301 CCATGACCCTG CAGAGCCAGT TCAAGTGTA GTTACATGAA CTGGTACCAG  
1351 CAGAAGTCAG GCACCTCCCC CAAAGATGG ATTTATGACA CATCCAAGT  
1401 GGCTTCTGGA GTCCCTTATC GCTTCAGTGG CAGTGGGTCT GGGACCTCAT  
1451 ACTCTCTCAC AATCAGCAGC ATGGAGGCTG AAGATGCTGC CACTTATTAC  
1501 TGCCAACAGT GGAGTAGTAA CCCGCTCAGG TTCGGTGCTG GGACCAAGCT  
1551 GGAGCTGAAA CATCATCACC ATCATCATTA G

## Figure 3B

3-5 (vLvH) x anti-CD3 (SEQ ID NO: 30)

```
1  MGWSCIIILFL VATAATGVHSA RELVMTQTPL SLPVSLGDQA SISCSSQSL
51  VHSNGNTYLH WYLQKPGQSP KLLIYKVSNR FSGVPDRFSG SSGTDFTLK
101 ISRVEAEDLG VYFCSQSTHV PYTFGGGTKL EIKGGGGSGG GSGGGGSEV
151 QLLEQSGAEL VRPGTSVKLS CKASGYFTS YGLSWVKQRT GQGLEWIGEV
201 YPRIGNAYYN EKEKGKATLT ADKSSSTASM ELRLTSEDS AVYFCARRGS
251 YGSNYDWFED VWGQGTTVTV SSGGGGSDIK LQQSGAELAR PGASVKMSCK
301 TSGYTFTRYT MHWVKQRPQG GLEWIGYINP SRGYTNYNQK FKDKATLTID
351 KSSSTAYMQL SSLTSEDSAV YYCARYYDDH YCLDYWGQGT TLTVSSVEGG
401 SGGSGSGSGS GGVDDIQLTQ SPAIMSASPG EKVTMTCRAS SSVSYMNWYQ
451 QKSGTSPKRW IYDTSKVASG VPYRFSGSGS GTSYSLTISS MEAEDAATYY
501 CQQWSSNPLT FGAGTKLELK HHHHHH*
```

## Figure 3B (continued)

SEQ ID NO:29:

1 ATGGGATGGA GCTGTATCAT CCTTCTTG GTAGCAACAG CTACAGGTGT  
51 ACACTCCGG CGGAGCTCG TGATGACCCA GACTCCACTC TCCCTGCCCTG  
101 TCAGTCTTGG AGATCAAGCC TCCATCTCTT GCAGATCTAG TCAGAGCCTT  
151 GTACACAGTA ATGGAACAC CTATTACAT TGGTACCCTGC AGAAGCCAGG  
201 CCAGTCTCCA AAGTCTCTGA TCTACAAAGT TTCCAACCGA TTCTCTGGGG  
251 TCCCAGACAG GTTCAGTGGC AGTGATCAG GGACAGATT CACACTCAAG  
301 ATCAGCAGAG TGGAGGCTGA GGATCTGGA GTTATTCT GCTCTCAAAG  
351 TACACATGTT CCGTACACGT TCGGAGGGG GACCAAGCTT GAGATCAAAG  
401 GTGGTGGTGG TTCTGGCGGC GGCGCTCCG GTGGTGGTGG TTCTGAGGTG  
451 CAGCTGCTCG AGCAGTCTGG AGCTGAGCTG GTAAGGCTG GGACTTCAGT  
501 GAAGCTGTCC TGCAAGGCTT CTGGCTACAC CTTCACAAGC TATGGTTTAA  
551 GCTGGGTGAA GCAGAGAACT GGACAGGGCC TTGAGTGGAT TGGAGAGGT  
601 TATCCTAGAA TTGGTAATGC TTAATAAAT GAGAAGTTCA AGGCAAGGC  
651 CACACTGACT GCAGACAAAT CCTCCAGCAC AGCGTCCATG GAGCTCCGCA  
701 GCCTGACATC TGAGGACTCT GCGGTCTATT TCTGTGCAAG ACGGGATCC  
751 TACGGTAGTA ACTACGACTG GTACTTCGAT GCTGGGGCC AAGGACCAC  
801 GGTCACCGTC TCCTCCGGAG GTGGTGGATC CGATATCAAA CTGCAGCAGT  
851 CAGGGGCTGA ACTGGCAAGA CCTGGGGCCT CAGTGAAGAT GTCCTGCAAG  
901 ACTTCTGGCT ACACCTTTAC TAGGTACACG ATGCACTGGG TAAACAGAG



## Figure 3B (continued)

951 GCCTGGACAG GGTCTGGAAT GGATTGGATA CATTAATCCT AGCCGTGGTT  
1001 ATACTAATTA CAATCAGAAG TTCAAGGACA AGCCACATT GACTACAGAC  
1051 AAATCCTCCA GCACAGCCTA CATGCAACTG AGCAGCCTGA CATCTGAGGA  
1101 CTCTGCAGTC TATTACTGTG CAAGATATTA TGATGATCAT TACTGCCTTG  
1151 ACTACTGGG CCAAGGCACC ACTCTCACAG TCTCCTCAGT CGAAGGTGGA  
1201 AGTGGAGGTT CTGGTGGAAG TGGAGGTTCA GGTGGAGTCG ACGACATTCA  
1251 GCTGACCCAG TCTCCAGCAA TCATGTCTGC ATCTCCAGGG GAGAAGGTCA  
1301 CCATGACCCTG CAGAGCCAGT TCAAGTGTA GTTACATGAA CTGGTACCAG  
1351 CAGAAGTCAG GCACCTCCCC CAAAAGATGG ATTTATGACA CATCCAAGT  
1401 GGCTTCTGGA GTCCCTTATC GCTTCAGTGG CAGTGGGTCT GGGACCTCAT  
1451 ACTCTCTCAC AATCAGCAGC ATGGAGGCTG AAGATGCTGC CACTTATTAC  
1501 TGCCAACAGT GGAGTAGTAA CCCGCTCACG TTCGGTGCTG GGACCAAGCT  
1551 GGAGCTGAAA CATCATCACC ATCACATTA G

## Figure 3C

3-1 (vLvH) x anti-CD3 (SEQ ID NO: 36)

```
1  MGWSCIILFL VATAATGVHSE LVMTQSPSYL AASPGETITI NCRASKSISK
51  YLAWYQEKPG KTNKLLIYSG STLQSGIPSR FSGSGGTDF TLTSSLEPE
101 DFAMYYCQQH NEYPYTFGGG TKLEIKGGGG SGGGSGGGG SEVQLLEQSG
151 AELVKPGASV KISCKASGYA FTNYWLGWVK QRPGHGLEWI GDLEFPGSGNT
201 HYNFRFRGKA TLTADKSSST AFMQLSSLTS EDSAVYFCAR LRNWDEAMDY
251 WQGGTTVTVS SGGGSDIKL QQSGAELARP GASVKMSCKT SGYTFTRYTM
301 HWVKQRPQGQ LEWIGYINPS RGYTNYNQKF KDKATLTIDK SSSTAYMQLS
351 SLTSEDNAVY YCARYYDDHY CLDYWGQGT LTVSSVEGGS GSGGSGGSGG
401 GVDDIQLTQS PAIMSASPGE KVTMTCRASS SVSYMNWYQQ KSGTSPKRWI
451 YDTSKVASGV PYRFGSGSGG TSYSLTISSM EAEDAATYYC QQWSSNPLTF
501 GAGTKLELKH HHHHH*
```

## Figure 3C (continued)

SEQ ID NO: 35

```
1  ATGGGATGGA GCTGTATCAT CCTCTTCTTG GTAGCAACAG CTACAGGTGT
51  ACACTCCGAG CTCGTCATGA CCCAGTCTCC ATCTTATCTT GCTGCATCTC
101 CTGGAGAAAC CATTACTATT AATTGCAGGG CAAGTAAGAG CATTAGCAAA
151 TATTTAGCCT GGTATCAAGA GAAACCTGGG AAACTAATA AGCTTCTTAT
201 CTACTCTGGA TCCACTTTGC AATCTGGAAT TCCATCAAGG TTCAGTGGCA
251 GTGGATCTGG TACAGATTTC ACTCTACCA TCAGTAGCCT GGAGCCTGAA
301 GATTTTGCAA TGTATTACTG TCAACAGCAT AATGAATATC CGTACACGTT
351 CGGAGGGGG ACCAAGCTTG AGATCAAAGG TGGTGGTGGT TCTGGCGGCG
401 GCGGCTCCGG TGGTGGTGGT TCTGAGGTGC AGCTGCTCGA GCAGTCTGGA
451 GCTGAGCTGG TGAAACCTGG GGCTCAGTG AAGATATCCT GCAAGGCTTC
501 TGGATACGCC TTCACTAACT ACTGGCTAGG TTGGGTAAAG CAGAGGCCTG
551 GACATGGACT TGAGTGGATT GGAGATCTTT TCCCTGGAAG TGGTAATACT
601 CACTACAATG AGAGGTTTCA GGGCAAAGCC ACACTGACTG CAGACAAATC
651 CTCGAGCACA GCCTTTATGC AGCTCAGTAG CCTGACATCT GAGGACTCTG
701 CTGTCTATT CTGTGCAAGA TTGAGGAACT GGGACGAGGC TATGGACTAC
751 TGGGGCCAAG GGACCACGGT CACCGTCTCC TCCGGAGGTG GTGGATCCGA
801 TATCAAAC TG CAGCAGTCAG GGGCTGAACT GGCAAGACCT GGGCCTCAG
851 TGAAGATGTC CTGCAAGACT TCTGGCTACA CCTTTACTAG GTACACGATG
901 CACTGGGTAA AACAGAGGCC TGGACAGGGT CTGGAATGGA TTGGATACAT
```

**Figure 3C (continued)**

```
951 TAATCCTAGC CGTGGTTATA CTAATTACAA TCAGAAGTTC AAGGACAAGG
1001 CCACATTGAC TACAGACAAA TCCTCCAGCA CAGCCTACAT GCAACTGAGC
1051 AGCCTGACAT CTGAGGACTC TGCAGTCTAT TACTGTGCAA GATATTATGA
1101 TGATCATTAC TGCCTTGACT ACTGGGGCCA AGGCACCACT CTCACAGTCT
1151 CCTCAGTCGA AGTGGAAGT GGAGGTTCTG GTGGAAGTGG AGGTTCAGGT
1201 GGAGTCGACG ACATTCAGCT GACCCAGTCT CCAGCAATCA TGTCTGCATC
1251 TCCAGGGGAG AAGGTCACCA TGACCTGCAG AGCCAGTTCA AGTGTAAAGT
1301 ACATGAAC TG ACCAGCAG AAGTCAGGCA CCTCCCCCAA AAGATGGATT
1351 TATGACACAT CCAAGTGGC TTCTGGAGTC CCTTATCGCT TCAGTGGCAG
1401 TGGGTCTGGG ACCTCATACT CTCTCACAAT CAGCAGCATG GAGGCTGAAG
1451 ATGCTGCCAC TTATTACTGC CAACAGTGGA GTAGTAACCC GCTCACGTTT
1501 GGTGCTGGGA CCAAGCTGGA GCTGAAACAT CATCACCATC ATCATTAG
```

## Figure 3D

4-1 (VLVH) x anti-CD3 (SEQ ID NO: 39)

```
1  MGWSCIIILFL VATAATGVHSE LVMTQSPSSL SVSAGEKVTM SCKSSQSLLN
51  SGNQKNYLAW YQOKPGQPPK LLIYGASTRE SGVPDRFTGS GSGTDFTLTI
101 SSVQAEDLAV YYCONDYSYP YTFGGGTKLE IKGGGSGGG GSGGGSEVQ
151 LLEQSGAELV RPGTSVKISC KASGYAFTNY WLGWVKQRPG HGLEWVGDI
201 PGSGNAHYNE KFKGKATLTA DKSSYTAYMQ LSSLTSEDSA VYFCARLRNW
251 DEAMDYWGQG TTVTVSSGGG GSDIKLQQSG AELARPGASV KMSCKTSGYT
301 FTRYTMHWVK QRPQGGLWEI GYINPSRGYT NYNQKFKDKA TLTDKSSST
351 AYMQLSSLTS EDSAVYYCAR YYDDHYCLDY WGQGTTLTVS SVEGGSGSG
401 GSGGSGGVDD IQLTQSPAIM SASPGEKVTM TCRASSSVSY MNWYQQKSGT
451 SPKRWIYDTS KVASGVPPYRF SGSGSGTSYS LTSSMEAD AATYYCQQWS
501 SNPLTFGAGT KLELKHHHHH H*
```



## Figure 3D (continued)

SEQ ID NO: 38:

```
1  ATGGGATGGA  GCTGTATCAT  CCTCTTCTTG  GTAGCAACAG  CTACAGGTGT
51  ACACTCCGAG  CTCGTGATGA  CACAGTCTCC  ATCCTCCCTG  AGTGTGTCAG
101 CAGGAGAGAA  GGTCACTATG  AGCTGCAAGT  CCAGTCAGAG  TCTGTAAAC
151 AGTGGAAATC  AAAAGAACTA  CTTGGCCTGG  TACCAGCAGA  AACCAGGGCA
201 GCCTCCTAAA  CTGTTGATCT  ACGGGGCATC  CACTAGGGAA  TCTGGGGTCC
251 CTGATCGCTT  CACAGGCAGT  GGATCTGGAA  CAGATTTCAC  TCTCACCATC
301 AGCAGTGTGC  AGGCTGAAGA  CCTGGCAGTT  TATTACTGTC  AGAATGATTA
351 TAGTTATCCG  TACACGTTCC  GAGGGGGAC  CAAGCTTGAG  ATCAAAGGTG
401 GTGGTGGTTC  TGGCGCGGC  GGCTCCGGTG  GTGGTGGTTC  TGAGGTGCAG
451 CTGCTCGAGC  AGTCTGGAGC  TGAGCTGGTA  AGGCTGGGA  CTTCAGTGAA
501 GATATCCTGC  AAGGCTTCTG  GATACGCCTT  CACTAACTAC  TGGCTAGGTT
551 GGGTTAAGCA  GAGGCCCTGA  CATGGACTTG  AATGGGTGG  AGATAATTTC
601 CCTGGAAGTG  GTAATGCTCA  CTACAATGAG  AAGTCAAGG  GCAAAGCCAC
651 ACTGACTGCA  GACAAGTCCT  CGTACACAGC  CTATATGCAG  CTCAGTAGCC
701 TGACATCTGA  GGACTCTGCT  GTCTATTCT  GTGCAAGATT  GCGGAAGTGG
751 GACGAGGCTA  TGGACTACTG  GGGCCAAGGG  ACCACGGTCA  CCGTCTCCTC
801 CGGAGGTGGT  GGATCCGATA  TCAAACCTGCA  GCAGTCAGGG  GCTGAACTGG
851 CAAGACCTGG  GGCTCAGTG  AAGATGTCCT  GCAAGACTTC  TGGCTACACC
901 TTACTAGGT  ACACGATGCA  CTGGGTAAAA  CAGAGGCCCTG  GACAGGTCT
```

**Figure 3D (continued)**

951 GGAATGGATT GGATACATTA ATCTAGCCG TGGTTATACT AATTACAATC  
1001 AGAAGTTCAA GGACAAGGCC ACATTGACTA CAGACAAATC CTCAGCACA  
1051 GCCTACATGC AACTGAGCAG CCTGACATCT GAGGACTCTG CAGTCTATTA  
1101 CTGTGCAAGA TATTATGATG ATCATTACTG CCTTGACTAC TGGGCCAAG  
1151 GCACCACTCT CACAGTCTCC TCAGTCGAAG GTGGAAGTGG AGGTTCTGGT  
1201 GGAAGTGGAG GTTCAGGTGG AGTCGACGAC ATTCAGCTGA CCCAGTCTCC  
1251 AGCAATCATG TCTGCATCTC CAGGGAGAA GGTCACCATG ACCTGCAGAG  
1301 CCAGTTCAAG TGTAAATTAC ATGAACTGGT ACCAGCAGAA GTCAGGCACC  
1351 TCCCCCAAAA GATGGATTTA TGACACATCC AAAGTGGCTT CTGGAGTCCC  
1401 TTATCGCTTC AGTGGCAGTG GGTCTGGGAC CTCATACTCT CTCACAATCA  
1451 GCAGCATGGA GGCTGAAGAT GCTGCCACTT ATTACTGCCA ACAGTGGAGT  
1501 AGTAAACCCGC TCACGTTCCG TGCTGGGACC AAGCTGGAGC TGAACATCA  
1551 TCACCATCAT CATTAG

## Figure 3E

5-10 (vLvH) x anti-CD3 (SEQ ID NO: 44)

```
1  MGWSCILILEL VATAIGVHSE LVMTQSPSSL TVTAGEKVTM SCKSSQSLLN
51  SGNQKNYLTW YQKPGQPPK LLIYWASTRE SGVPDRFTGS GSGTDFTLTI
101 SSVQAEDLAV YYCQNDYSYP LTFGAGTKLE IKGGGSGGG GSGGGSEVQ
151 LLEQSGAELV RPTSVKISC KASGYAFTNY WLGWVKQRP G HGLEWIGDIF
201 PGSGNIHYNE KEKGKATLTA DKSSSTAYMQ LSSLTFEDSA VYFCARLRNW
251 DEPMDYWGQG TTVTVSSGGG GSDIKLQQSG AELARPGASV KMSCKTSGYT
301 FTRYTMHWVK QRPQGGLWI GYINPSRGYT NYNQKFKDKA TLTTDKSSST
351 AYMQLSSLTS EDSAVYYCAR YYDDHYCLDY WGQGTTLTVS SVEGGSGSG
401 GSGSGGVDD IQLTQSPAIM SASPGEKVTM TCRASSSVSY MNWYQQKSGT
451 SPKRWIYDTS KVASGVPRYF SGSGSGTSYS LTSSMEAE AATYYCQQWS
501 SNPLTFGAGT KLELKH HHHHH H*
```

## Figure 3E (continued)

SEQ ID NO: 43

```
1  ATGGGATGGA GCTGTATCAT CCTTCTTCTTG GTAGCAACAG CTACAGGTGT
51  ACACTCCGAG CTCGTGATGA CACAGTCTCC ATCCTCCCTG ACTGTGACAG
101 CAGGAGAGAA GGTCACTATG AGCTGCAAGT CCAGTCAGAG TCTGTTAAAC
151 AGTGGAATC AAAAGAACTA CTTGACCTGG TACCAGCAGA AACCAGGCA
201 GCCTCCTAAA CTGTTGATCT ACTGGGCATC CACTAGGAA TCTGGGGTCC
251 CTGATCGCTT CACAGGCAGT GGATCTGGAA CAGATTTCAC TCTCACCATC
301 AGCAGTGTGC AGGCTGAAGA CCTGGCAGTT TATTACTGTC AGAATGATTA
351 TAGTTATCCG CTCACGTTTC GTGCTGGGAC CAAGCTTGAG ATCAAAGGTG
401 GTGGTGGTTC TGGCGCGGC TGAGCTGGTA AGCCTGGGA CTTCAGTGAA
451 CTGCTCGAGC AGTCTGGAGC GATACGCCCTT CACTAACTAC TGGCTAGGTT
501 GATATCCTGC AAGGCTTCTG CATGGACTTG AGTGGATTGG AGATAATTTC
551 GGTAAAGCA GAGGCCTGGA CTACAAATGAG AAGTCAAGG GCAAAGCCAC
601 CCTGGAAGTG GTAATATCCA CGAGCACAGC CTATATGCAG CTCAGTAGCC
651 ACTGACTGCA GACAAATCTT GTCTATTCT GTGCAAGACT GAGGAACTGG
701 TGACATTGA GGA CTCTGCT GGGCCAAGG ACCACGGTCA CCGTCTCCTC
751 GACGAGCCTA TGGACTACTG TCAAAC TGCA GAGTCA GGG GCTGAACTGG
801 CGGAGGTGGT GGATCCGATA AAGATGTCCT GCAAGACTTC TGGCTACACC
851 CAAGACCTGG GGCCTCAGTG CTGGGTAAAA CAGAGGCCCTG GACAGGGTCT
901 TTTACTAGGT ACACGATGCA
```

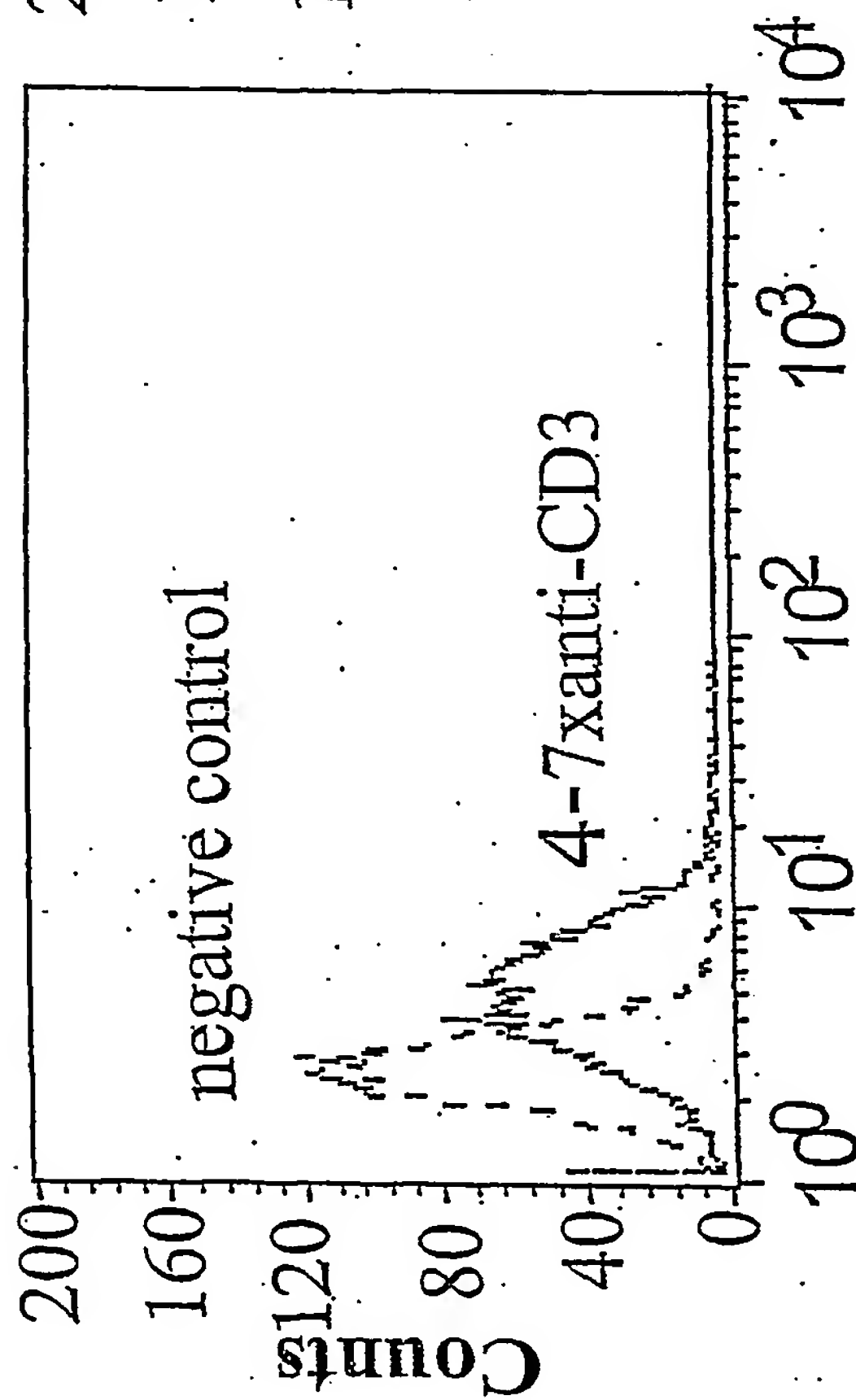
## Figure 3E (continued)

951 GGAATGGATT GGATACATTA ATCTAGCCG TGGTTATACT AATTACAATC  
1001 AGAAGTTCAA GGACAAGGCC ACATTGACTA CAGACAAATC CTCAGCACA  
1051 GCCTACATGC AACTGAGCAG CCTGACATCT GAGGACTCTG CAGTCTATTA  
1101 CTGTGCAAGA TATTATGATG ATCATTAATG CCTTGACTAC TGGGGCCAAG  
1151 GCACCACTCT CACAGTCTCC TCAGTCGAAG GTGGAAGTGG AGGTTCTGGT  
1201 GGAAGTGGAG GTTCAGGTGG AGTCGACGAC ATTCAGCTGA CCCAGTCTCC  
1251 AGCAATCATG TCTGCATCTC CAGGGAGAA GGTCAACCATG ACCTGCAGAG  
1301 CCAGTTCAAG TGTAAGTTAC ATGAACTGGT ACCAGCAGAA GTCAGGCACC  
1351 TCCCCCAAAA GATGGATTTA TGACACATCC AAAGTGGCTT CTGGAGTCCC  
1401 TTATCGCTTC AGTGGCAGTG GGTCTGGGAC CTCATACTCT CTCACAATCA  
1451 GCAGCATGGA GGCTGAAGAT GCTGCCACTT ATTAAGTCCA ACAGTGGAGT  
1501 AGTAACCCGC TCACGTTTCGG TGCTGGGACC AAGCTGGAGC TGAACATCA  
1551 TCACCATCAT CATTAG

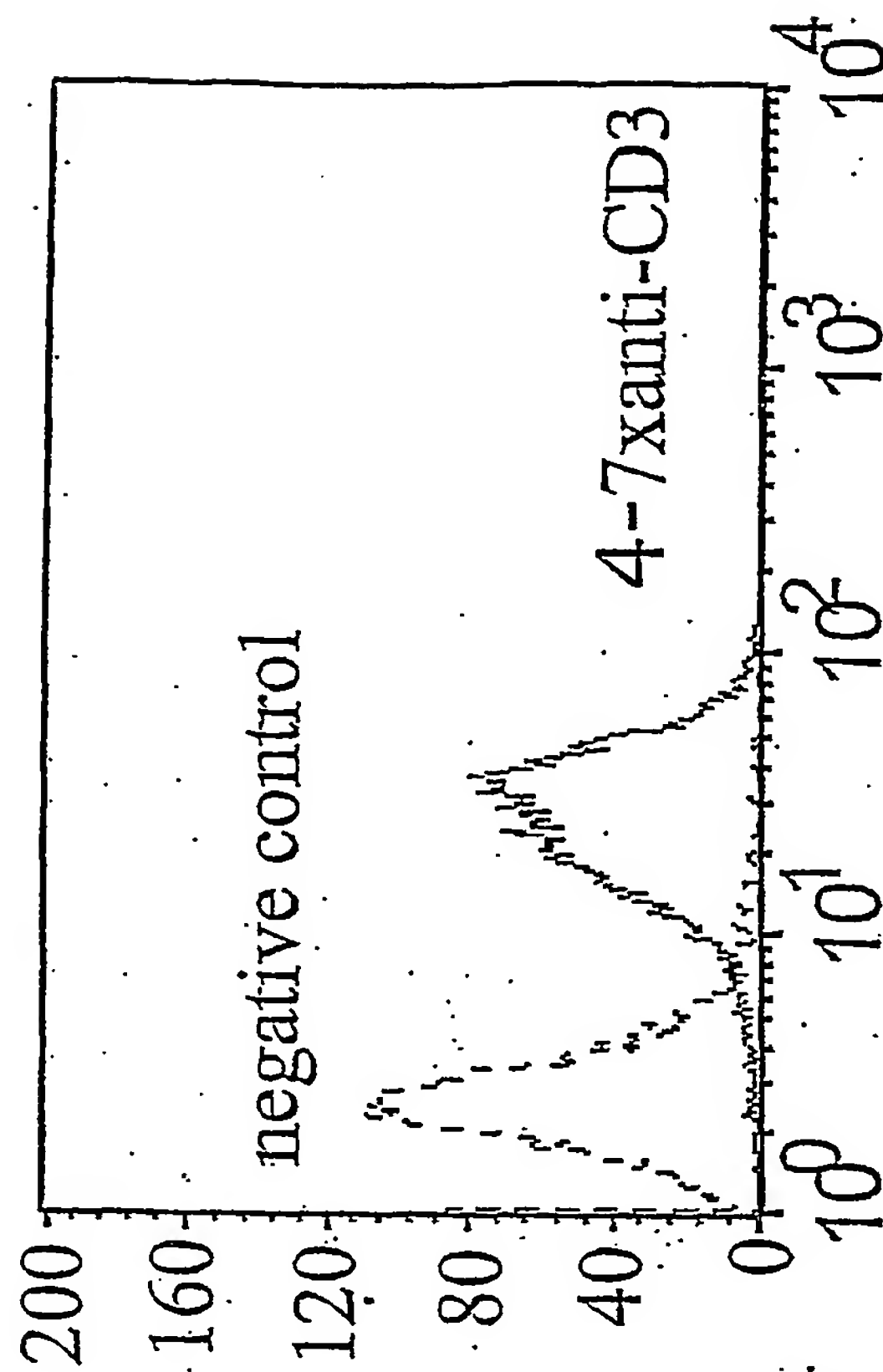


Figure 4A

CD3 Binding (Jurkat cells)



EpCAM Binding (Kato cells)

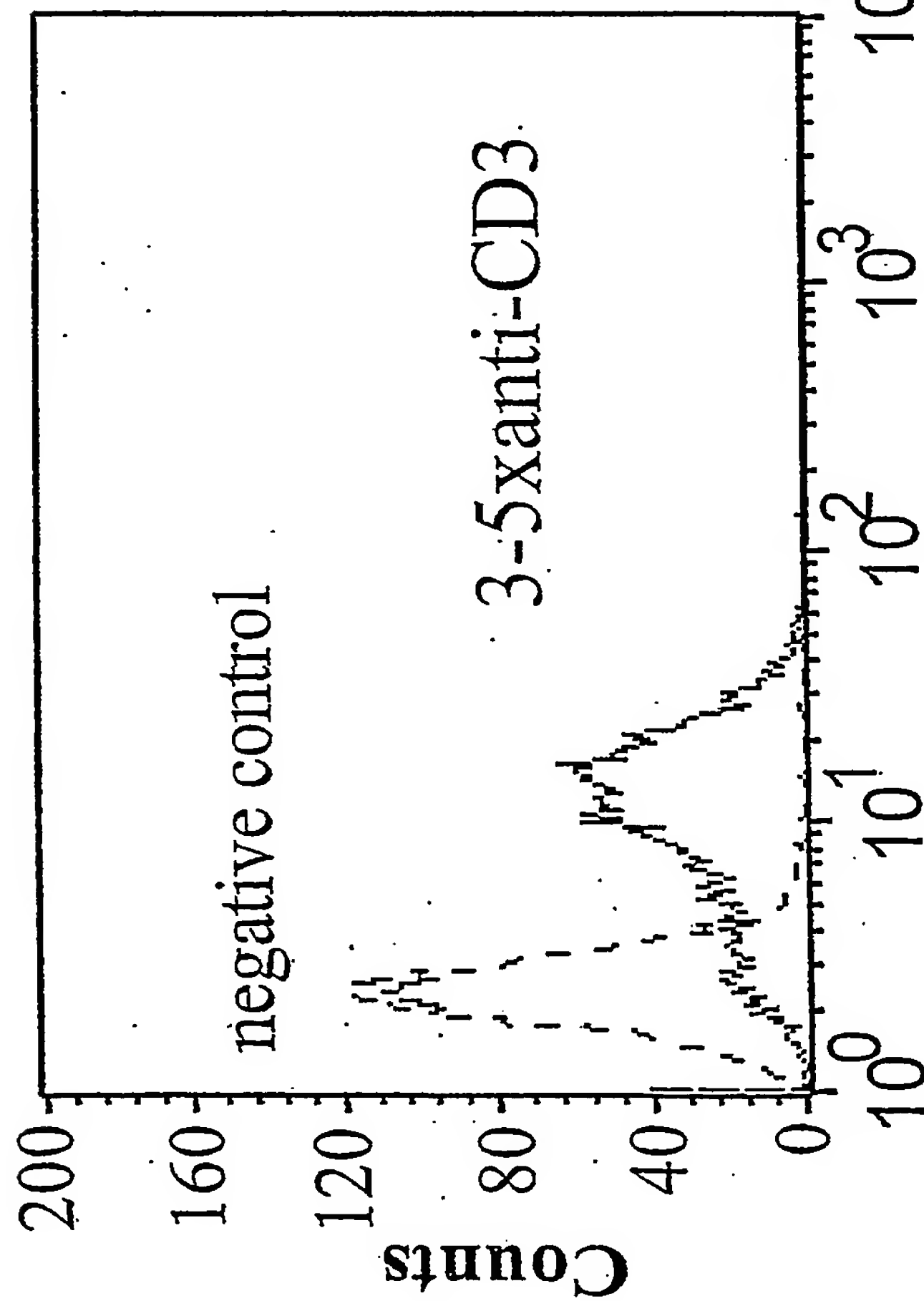


4-7xanti-CD3

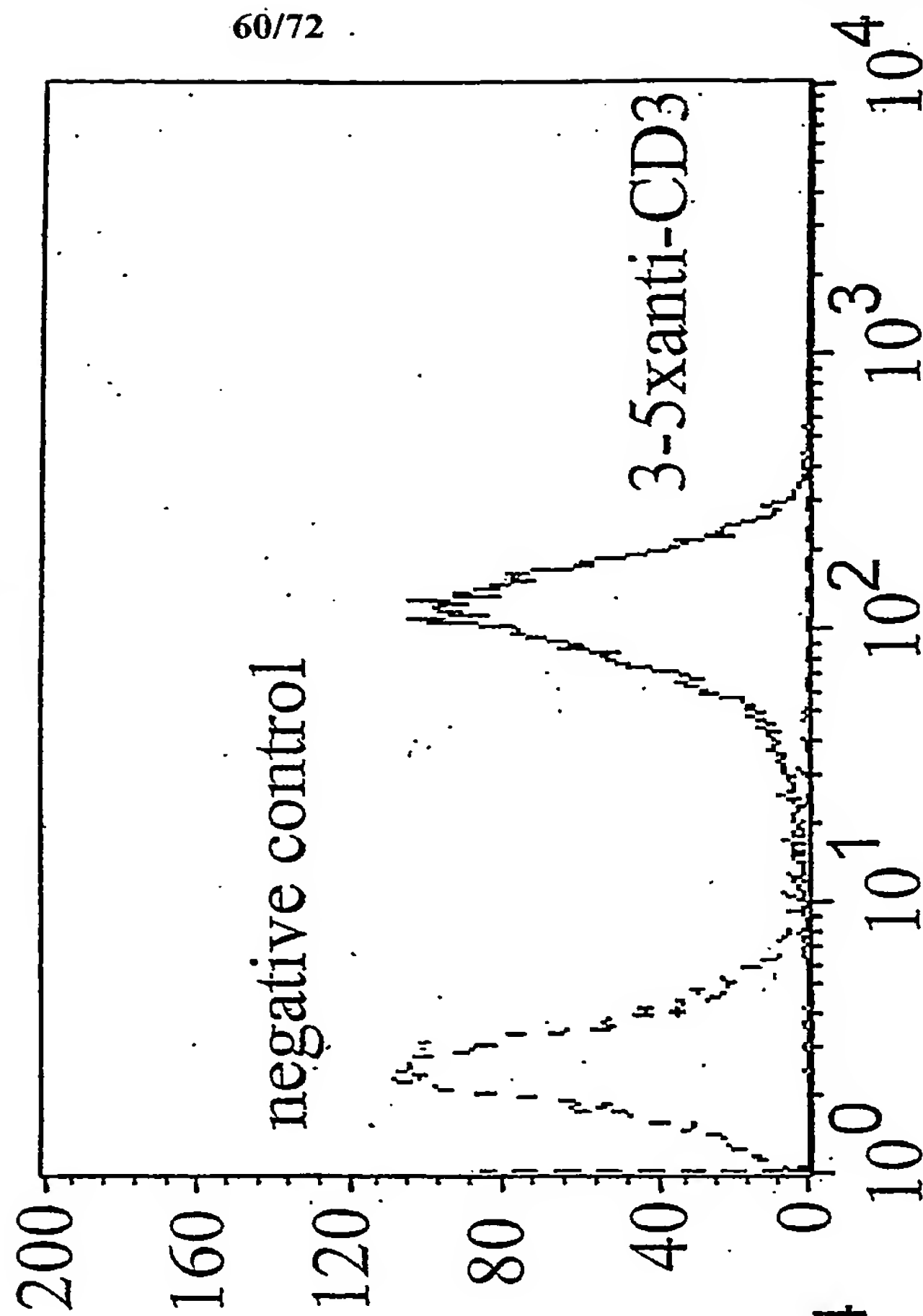
(SEQ ID NO:42)

**Figure 4B**

**CD3 Binding (Jurkat cells)**



**EpCAM Binding (Kato cells)**

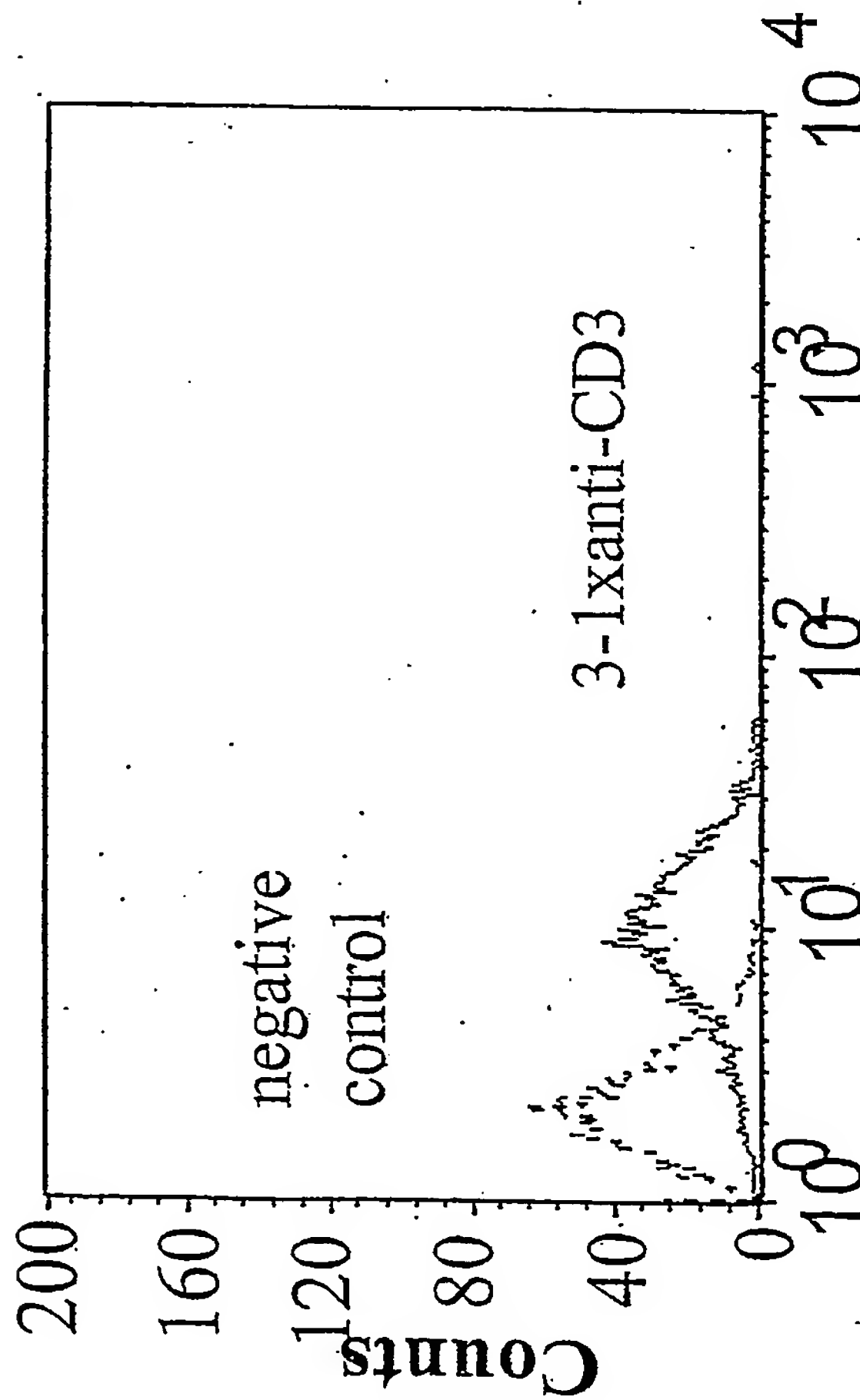


**3-5xanti-CD3**

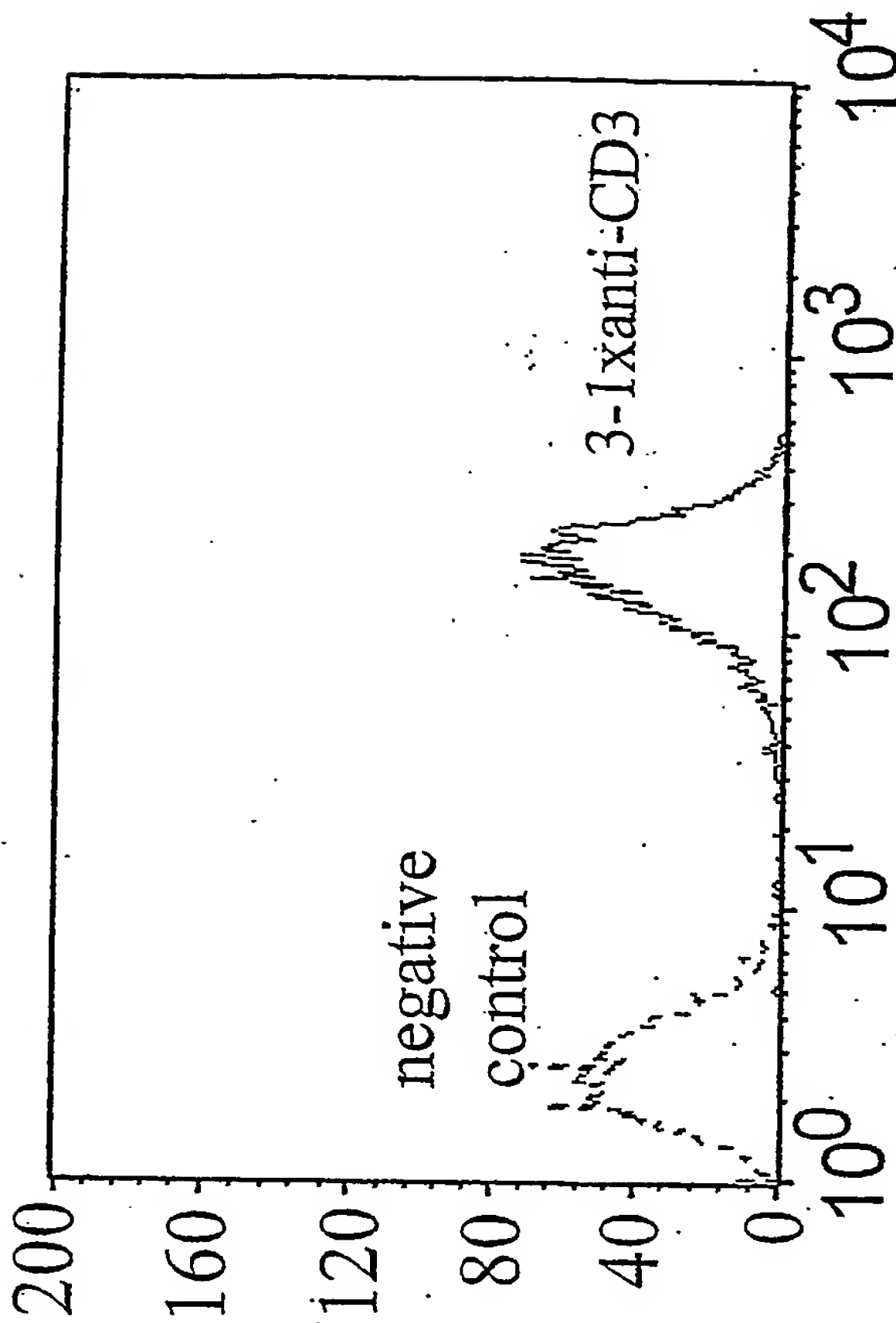
**(SEQ ID NO: 30)**

**Figure 4C**

**CD3 Binding (Jurkat cells)**



**EpCAM Binding (Kato cells)**



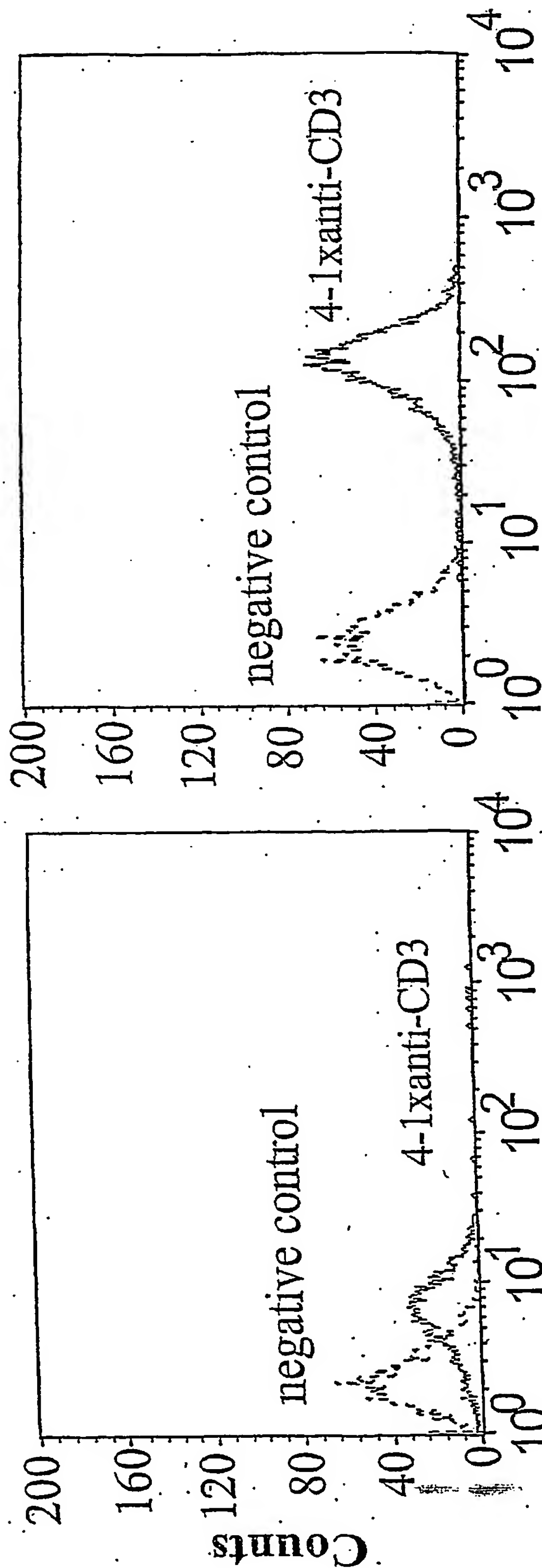
**3-1xanti-CD3**

**(SEQ ID NO:36)**

Figure 4D

CD3 Binding (Jurkat cells)

EpCAM Binding (Kato cells)

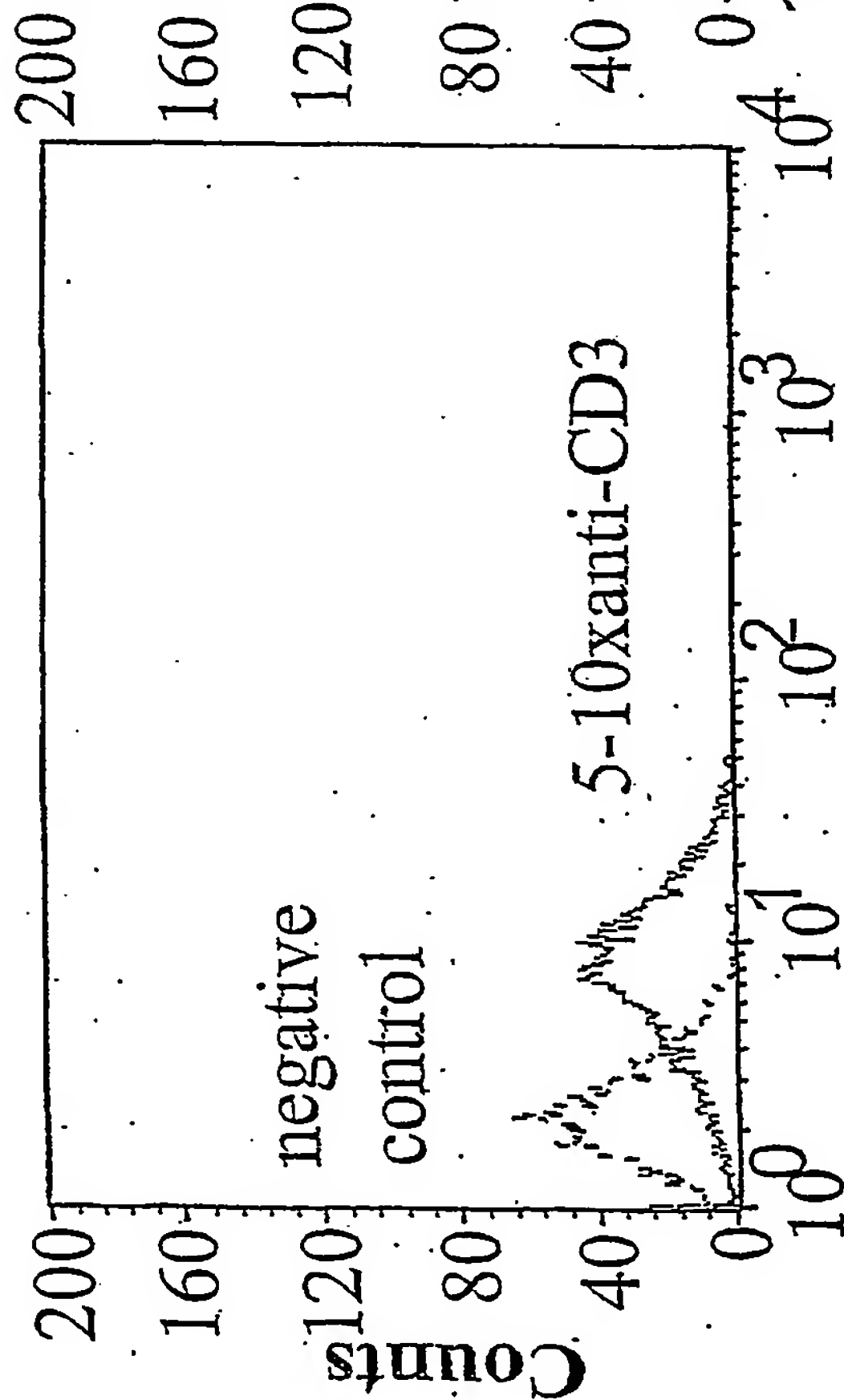


4-1xanti-CD3

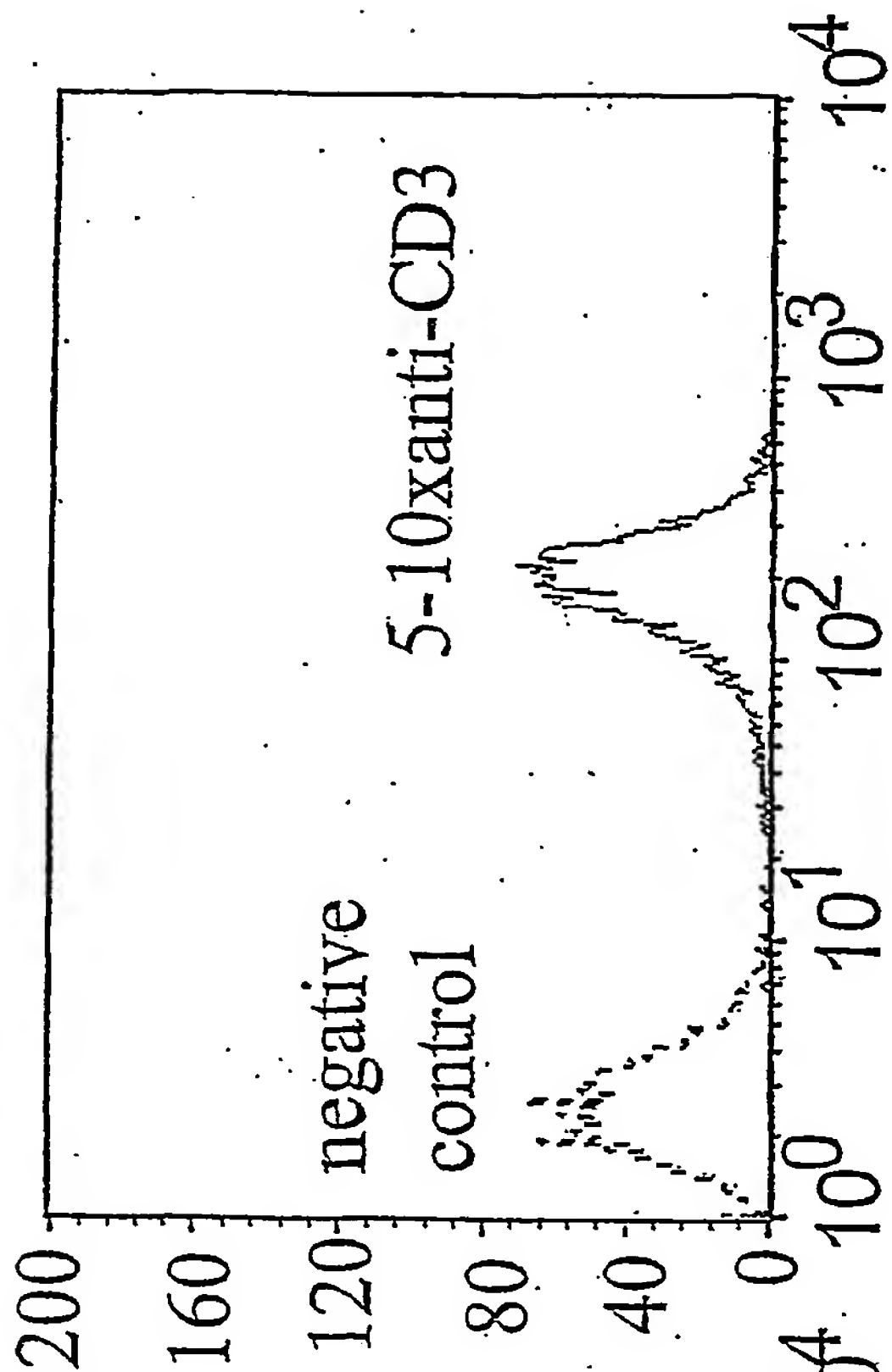
(SEQ ID NO: 39)

Figure 4E

CD3 Binding (Jurkat cells)



EpCAM Binding (Kato cells)



5-10xanti-CD3

(SEQ ID NO: 44)



Figure 5

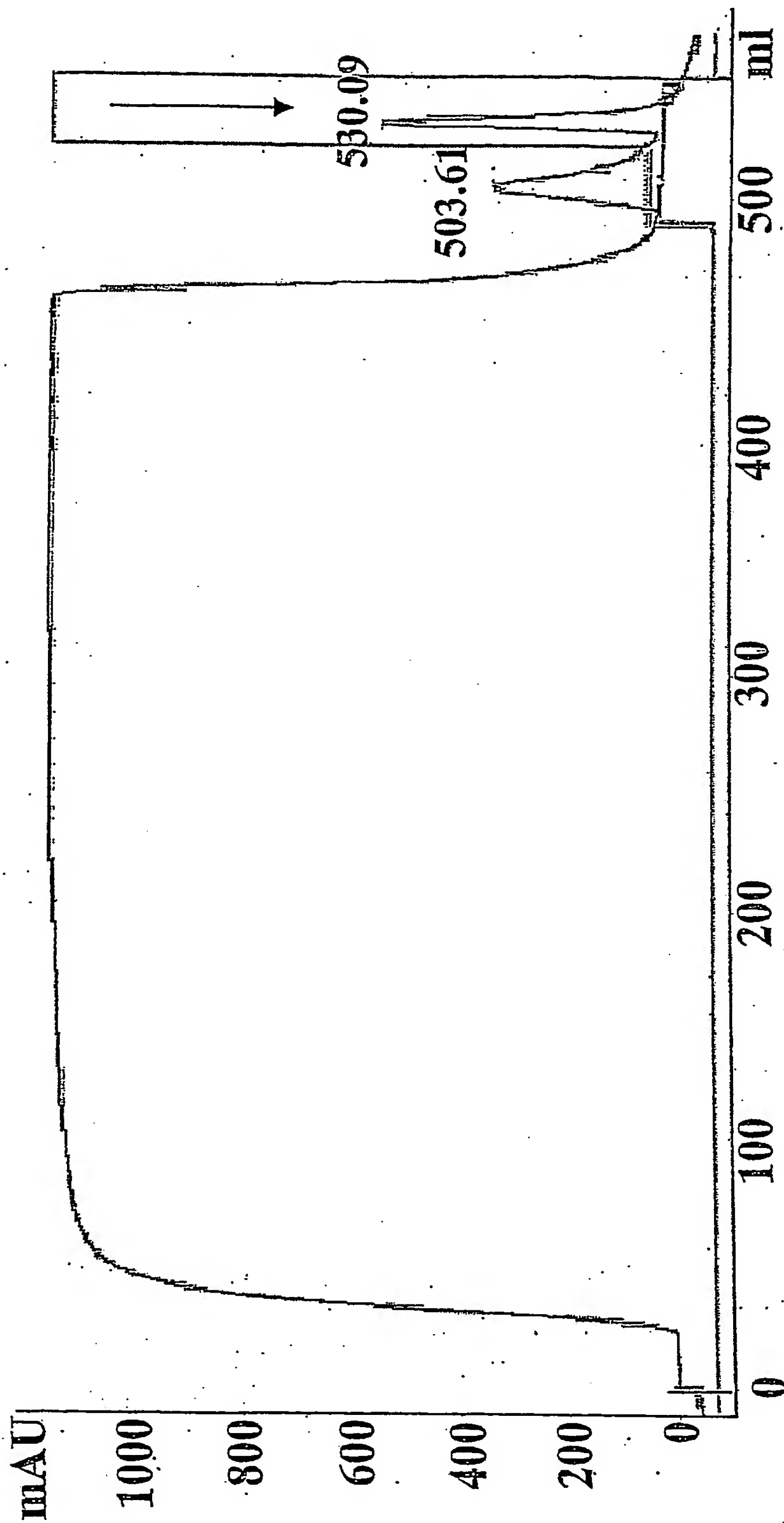


Figure 6

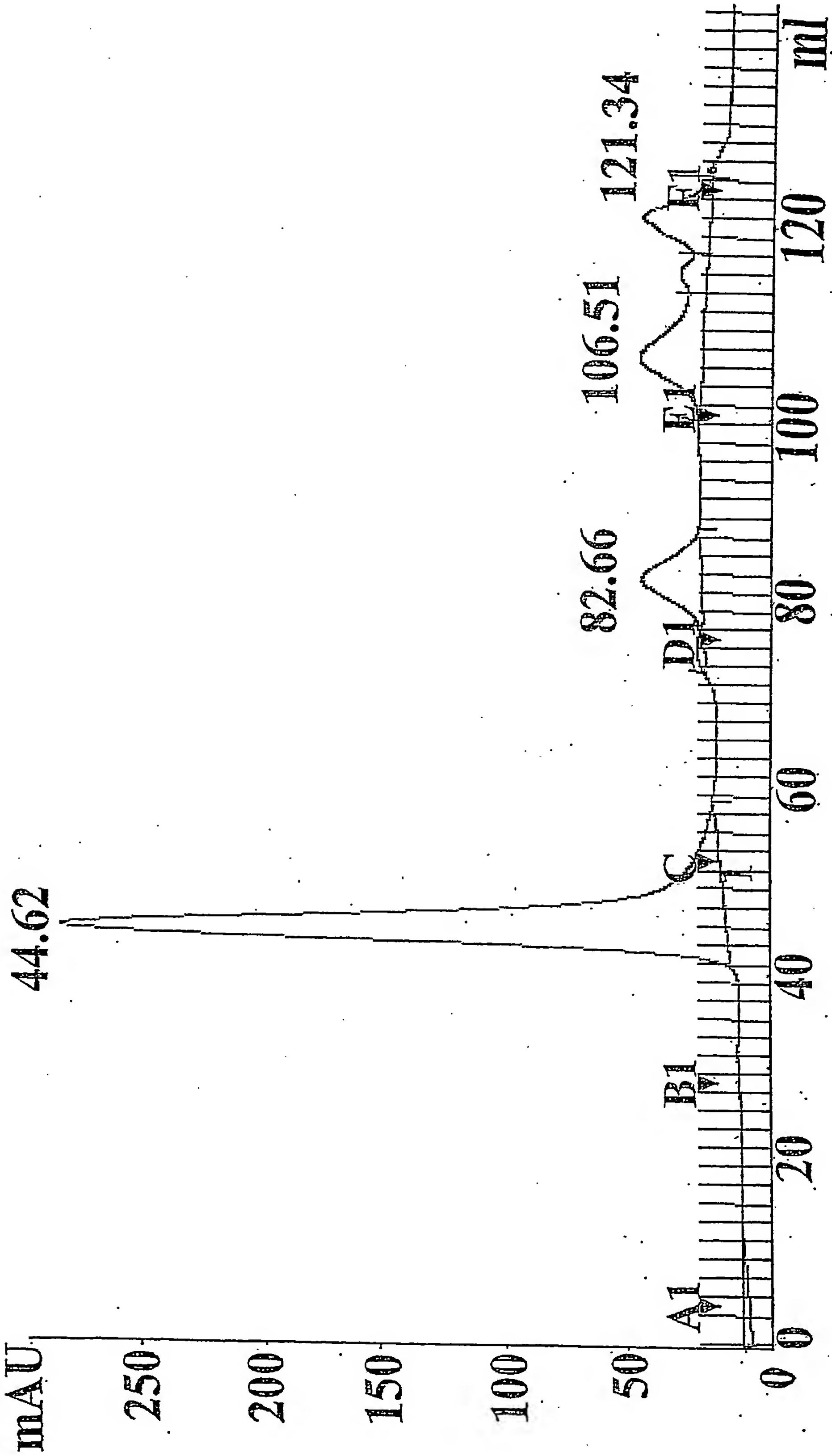


Figure 7A

3-1x anti-CD3

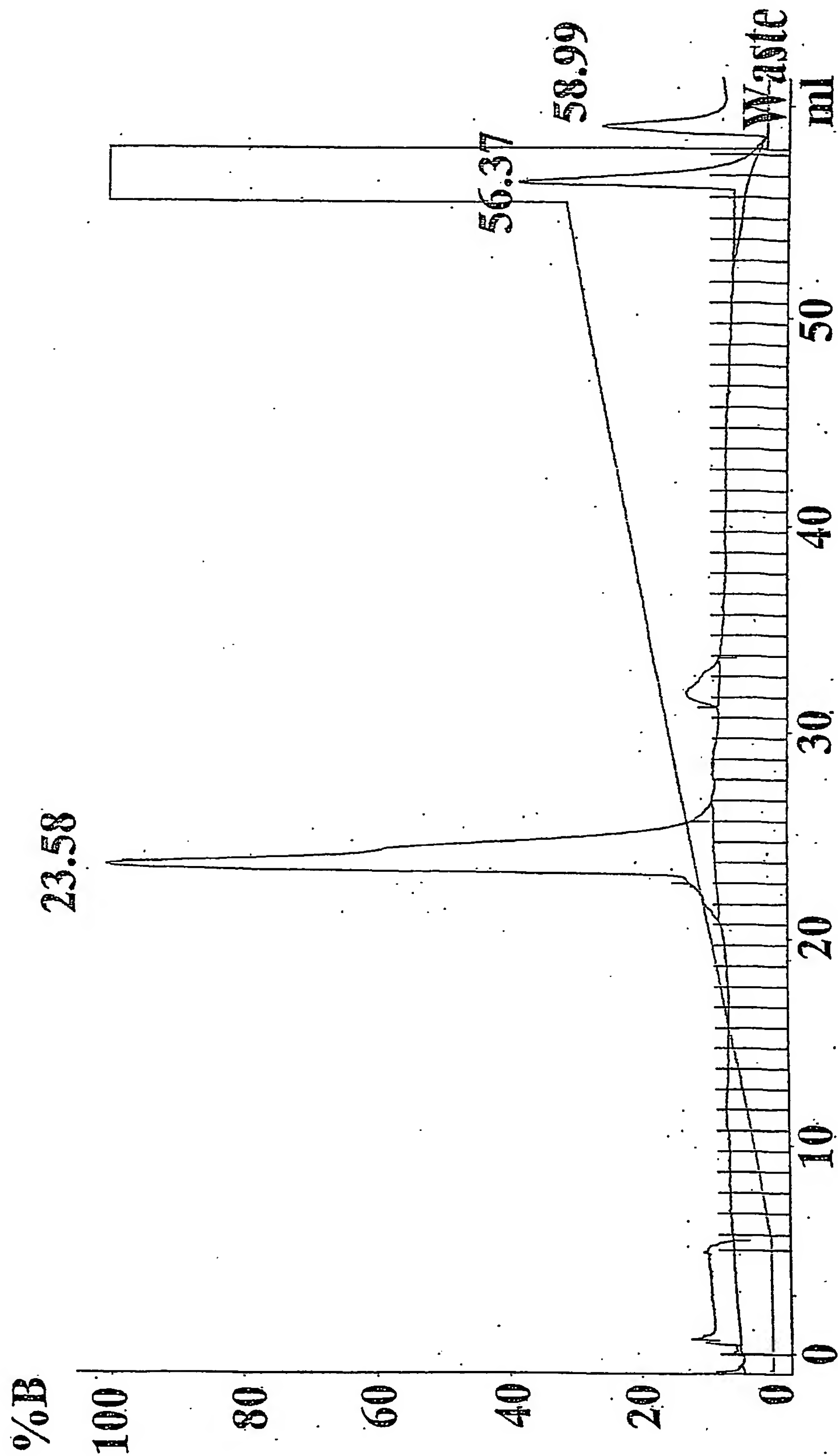
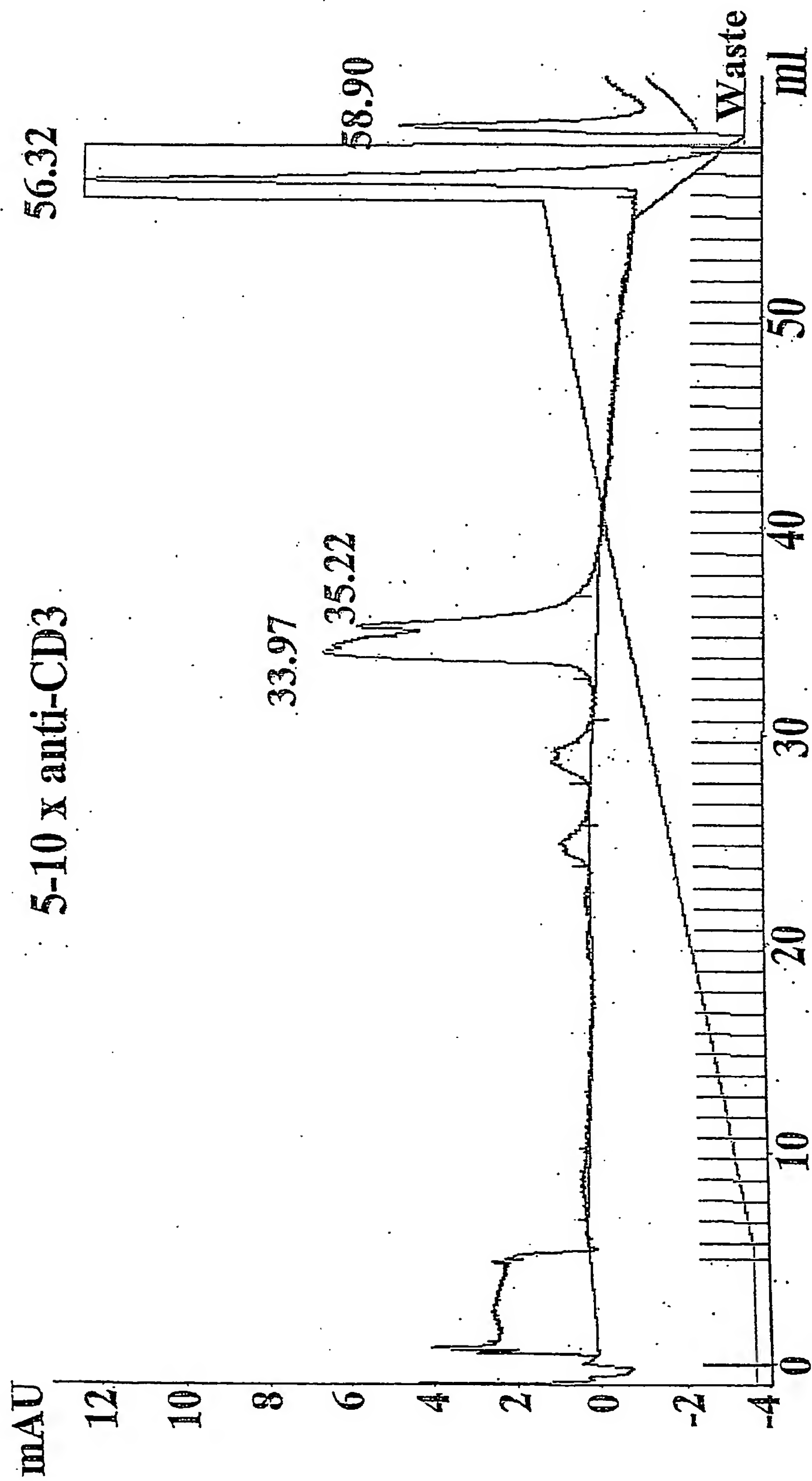
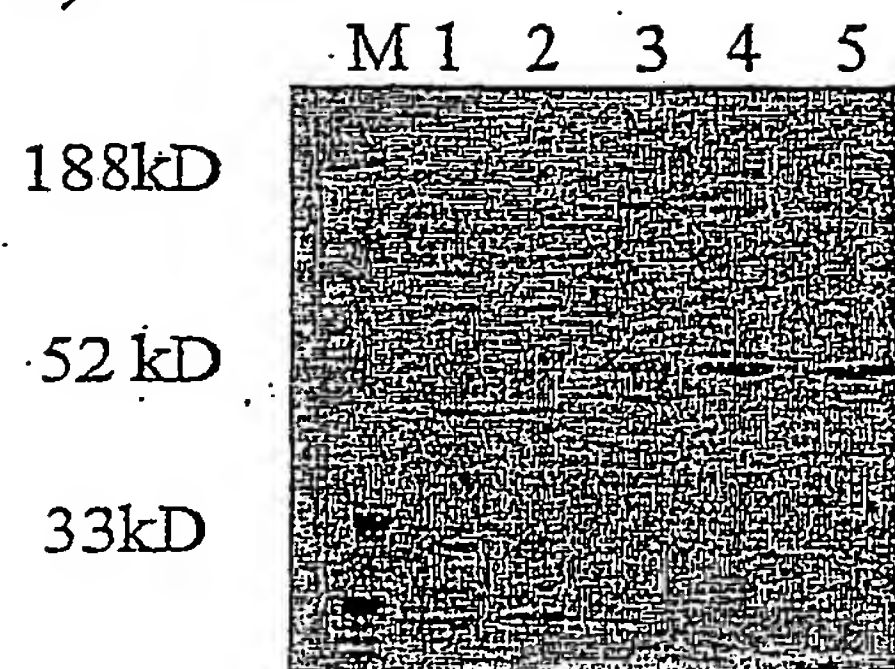
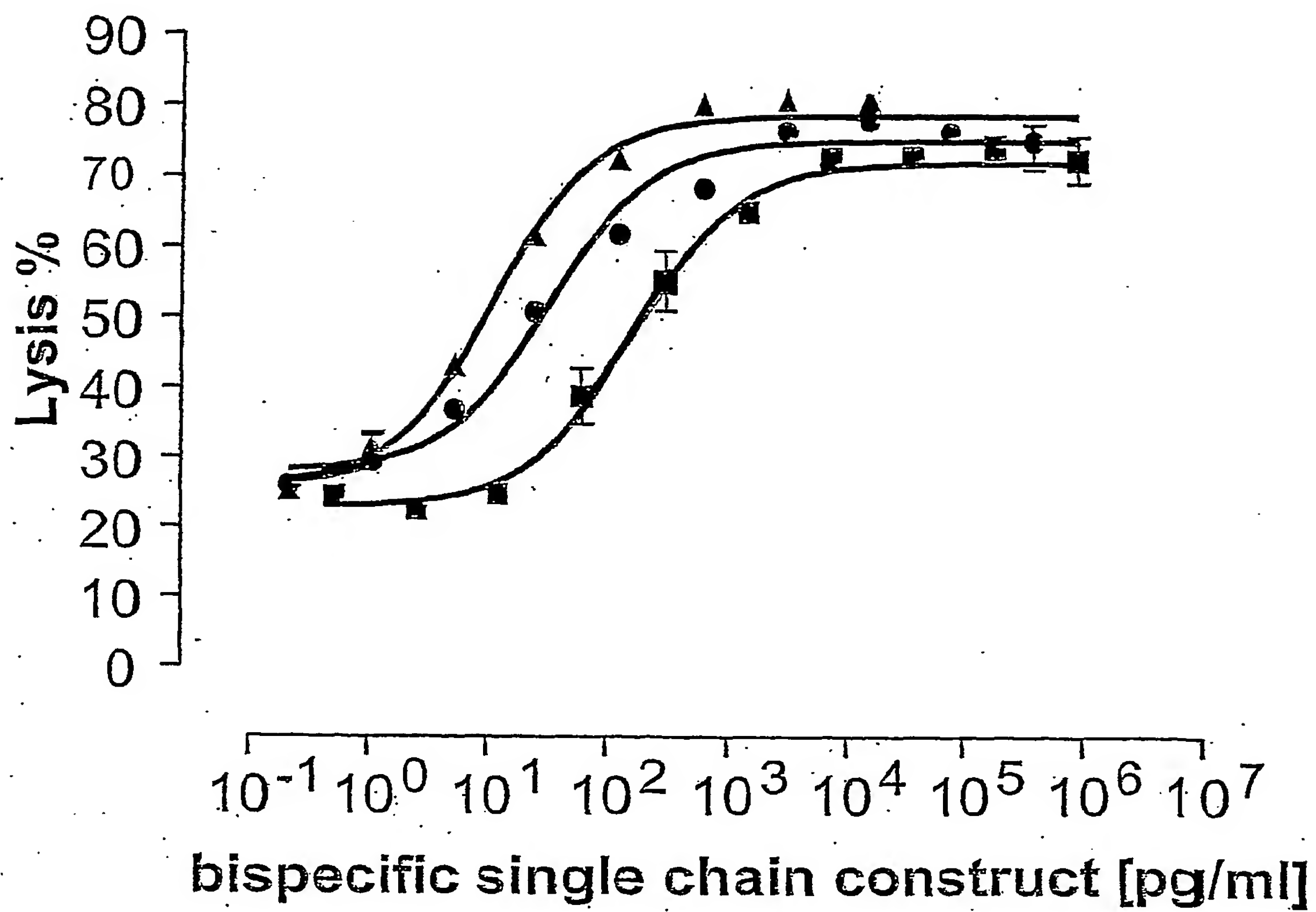


Figure 7B

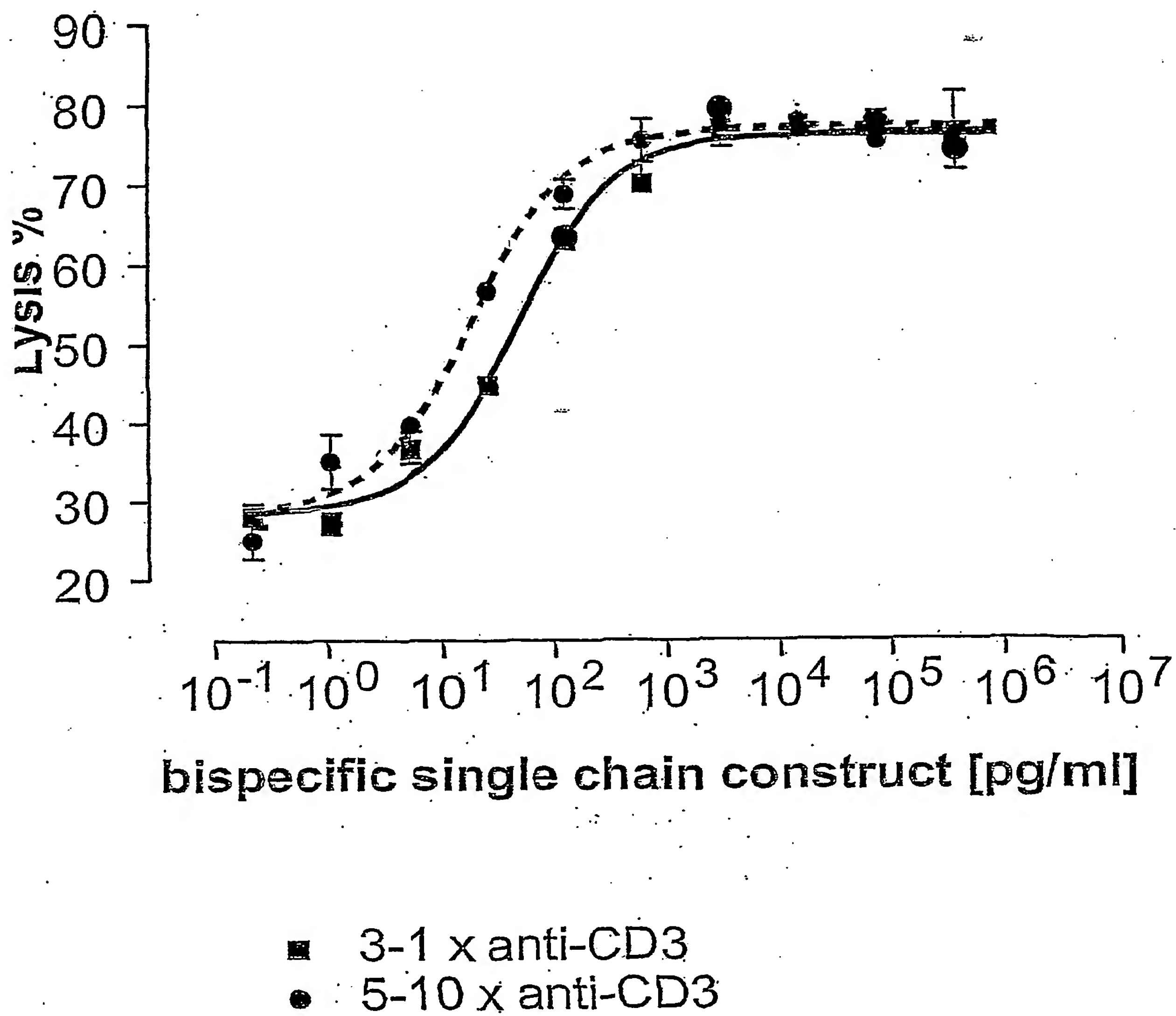


**Figure 8****A)****B)**



**Figure 9**

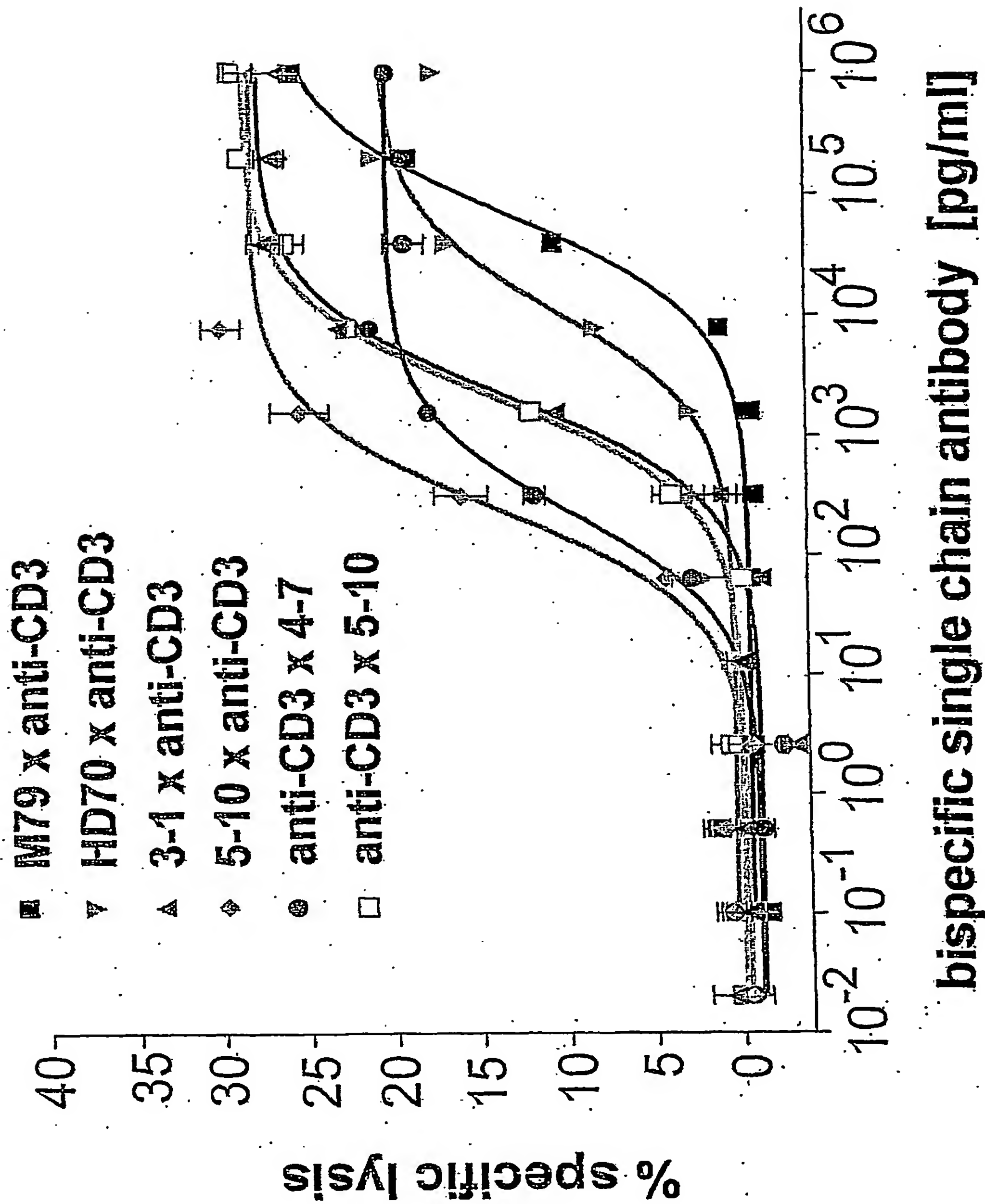
- anti-CD3x3-1
- anti-CD3 x 5-10
- ▲ anti-CD3 x 4-7

**Figure 10**

**Figure 11A**

3-1	LR <b>NWD</b> EAMDY
4-1	LR <b>NWD</b> EAMDY
5-10	LR <b>NWD</b> EPMDY
3-5	RGSYGS <b>NYD</b> WYFDV
4-7	RGSYDT <b>NYD</b> WYFDV
M79	MENWSFAY
HD70	DMGWGSGWRPYYYYGMDV
3B10	FTSPDY

**Figure 11B**



## SEQUENCE LISTING

AP20 Rec'd PCT/PTO 08 AUG 2006

&lt;110&gt; Micromet AG

&lt;120&gt; Pharmaceutical composition comprising a construct specific for EpCAM

&lt;130&gt; H1656 PCT

&lt;150&gt; EP 03012133.9

&lt;151&gt; 2003-05-31

&lt;150&gt; EP 03012134.7

&lt;151&gt; 2003-05-31

&lt;160&gt; 101

&lt;170&gt; PatentIn version 3.1

&lt;210&gt; 1

&lt;211&gt; 1521

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 4-7 VHVL

&lt;400&gt; 1

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctctcagtc	360
gaaggtggaa gtggagggttc tgggtggaagt ggagggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtaccagc agaagtcagg cacctcccc	540



2

```

aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc 600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc 660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg 720
gagctgaaat ccggaggtgg tggatccgag gtgcagctgc tcgagcagtc tggagctgag 780
ctggcgagggc ctgggggcttc agtgaagctg tcctgcaagg cttctggcta caccttcaca 840
aactatgggtt taagctgggt gaagcagagg cctggacagg tccttgagtg gattggagag 900
gtttatccta gaattggtaa tgcttactac aatgagaagt tcaagggcaa ggccacactg 960
actgcagaca aatcctccag cacagcgtcc atggagctcc gcagcctgac ctctgaggac 1020
tctgcggtct atttctgtgc aagacgggga tcctacgata ctaactacga ctggtacttc 1080
gatgtctggg gccaagggac cacggtcacc gtctcctcag gtggtggtgg ttctggcggc 1140
ggcggctccg gtggtggtgg ttctgagctc gtgatgacc agactccact ctccctgcct 1200
gtcagtcttg gagatcaagc ctccatctct tgcagatcta gtcagagcct tgtacacagt 1260
aatggaaaca cctatttaca ttggtacctg cagaagccag gccagtctcc aaagctcctg 1320
atctacaaag tttccaaccg attttctggg gtcccagaca ggttcagtgg cagtggatca 1380
gggacagatt tcacactcaa gatcagcaga gtggaggctg aggatctggg agtttatttc 1440
tgctctcaaa gtacacatgt tccgtacacg ttcggagggg ggaccaagct tgagatcaaa 1500
catcatcacc atcatcatta g 1521

```

&lt;210&gt; 2

&lt;211&gt; 506

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 4-7 VHVL

&lt;400&gt; 2

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
165 170 175

Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
180 185 190

Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
195 200 205

Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
210 215 220

Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
225 230 235 240

Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
245 250 255

Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala Ser Val Lys Leu Ser Cys  
260 265 270

Lys Ala Ser Gly Tyr Thr Phe Thr Asn Tyr Gly Leu Ser Trp Val Lys  
275 280 285

Gln Arg Pro Gly Gln Val Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg  
290 295 300

Ile Gly Asn Ala Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
305 310 315 320

Thr Ala Asp Lys Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu  
325 330 335

Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr  
340 345 350

4

Asp Thr Asn Tyr Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr  
 355 360 365  
 Val Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly  
 370 375 380  
 Gly Gly Gly Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro  
 385 390 395 400  
 Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser  
 405 410 415  
 Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys  
 420 425 430  
 Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg Phe  
 435 440 445  
 Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 450 455 460  
 Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr Phe  
 465 470 475 480  
 Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr Lys  
 485 490 495  
 Leu Glu Ile Lys His His His His His His  
 500 505

&lt;210&gt; 3

&lt;211&gt; 1512

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 5-10 VHVL

&lt;400&gt; 3

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctctcagtc	360
gaaggtggaa gtggaggttc tgggtggaagt ggaggttcag gtggagtcga cgacattcag	420

5

```

ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc      480
agagccagtt caagtgtaag ttacatgaac tggtagcagc agaagtcagg cacctcccccc      540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc      600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc      660
acttattact gccaacagtg gagtagtaac ccgctcacgt tccggtgctgg gaccaagctg      720
gagctgaaat ccggaggtgg tggatccgag gtgcagctgc tgcagcagtc tggagctgag      780
ctggtaaggc ctgggacttc agtgaagata tcctgcaagg cttctggata cgccttcact      840
aactactggc taggttgggt aaagcagagg cctggacatg gacttgagtg gattggagat      900
attttccctg gaagtggtaa tatccactac aatgagaagt tcaagggcaa agccacactg      960
actgcagaca aatcttcgag cacagcctat atgcagctca gtagcctgac atttgaggac     1020
tctgctgtct atttctgtgc aagactgagg aactgggacg agcctatgga ctactggggc     1080
caagggacca cggtcaccgt ctctcaggt ggtggtggtt ctggcggcgg cggctccggt     1140
ggtggtggtt ctgagctcgt gatgacacag tctccatcct ccctgactgt gacagcagga     1200
gagaagggtca ctatgagctg caagtccagt cagagtctgt taaacagtgg aaatcaaaag     1260
aactacttga cctggtacca gcagaaacca gggcagcctc ctaaactggt gatctactgg     1320
gcatccacta gggaaatctgg ggtccctgat cgcttcacag gcagtggatc tggaacagat     1380
ttcactctca ccatcagcag tgtgcaggct gaagacctgg cagtttatta ctgtcagaat     1440
gattatagtt atccgctcac gttcggtgct gggaccaagc ttgagatcaa acatcatcac     1500
catcatcatt ag                                     1512

```

&lt;210&gt; 4

&lt;211&gt; 503

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 5-10 VHVL

&lt;400&gt; 4

```

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala
1       5       10      15

```

```

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr
20      25      30

```

```

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile
35      40      45

```

```

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe

```

50						55			6	60					
Lys 65	Asp	Lys	Ala	Thr	Leu 70	Thr	Thr	Asp	Lys	Ser 75	Ser	Ser	Thr	Ala	Tyr 80
Met	Gln	Leu	Ser	Ser 85	Leu	Thr	Ser	Glu	Asp 90	Ser	Ala	Val	Tyr	Tyr 95	Cys
Ala	Arg	Tyr	Tyr 100	Asp	Asp	His	Tyr	Cys 105	Leu	Asp	Tyr	Trp	Gly 110	Gln	Gly
Thr	Thr	Leu 115	Thr	Val	Ser	Ser	Val 120	Glu	Gly	Gly	Ser	Gly 125	Gly	Ser	Gly
Gly	Ser 130	Gly	Gly	Ser	Gly	Gly 135	Val	Asp	Asp	Ile	Gln 140	Leu	Thr	Gln	Ser
Pro 145	Ala	Ile	Met	Ser	Ala 150	Ser	Pro	Gly	Glu	Lys 155	Val	Thr	Met	Thr	Cys 160
Arg	Ala	Ser	Ser	Ser 165	Val	Ser	Tyr	Met	Asn 170	Trp	Tyr	Gln	Gln	Lys 175	Ser
Gly	Thr	Ser	Pro 180	Lys	Arg	Trp	Ile	Tyr 185	Asp	Thr	Ser	Lys	Val 190	Ala	Ser
Gly	Val	Pro 195	Tyr	Arg	Phe	Ser	Gly 200	Ser	Gly	Ser	Gly	Thr 205	Ser	Tyr	Ser
Leu	Thr 210	Ile	Ser	Ser	Met	Glu 215	Ala	Glu	Asp	Ala	Ala 220	Thr	Tyr	Tyr	Cys
Gln 225	Gln	Trp	Ser	Ser	Asn 230	Pro	Leu	Thr	Phe	Gly 235	Ala	Gly	Thr	Lys	Leu 240
Glu	Leu	Lys	Ser	Gly 245	Gly	Gly	Gly	Ser	Glu 250	Val	Gln	Leu	Leu	Glu 255	Gln
Ser	Gly	Ala	Glu 260	Leu	Val	Arg	Pro	Gly 265	Thr	Ser	Val	Lys	Ile 270	Ser	Cys
Lys	Ala	Ser 275	Gly	Tyr	Ala	Phe	Thr 280	Asn	Tyr	Trp	Leu	Gly 285	Trp	Val	Lys
Gln	Arg 290	Pro	Gly	His	Gly	Leu 295	Glu	Trp	Ile	Gly	Asp 300	Ile	Phe	Pro	Gly
Ser 305	Gly	Asn	Ile	His	Tyr 310	Asn	Glu	Lys	Phe	Lys 315	Gly	Lys	Ala	Thr	Leu 320
Thr	Ala	Asp	Lys	Ser 325	Ser	Ser	Thr	Ala	Tyr 330	Met	Gln	Leu	Ser	Ser	Leu 335



7

Thr Phe Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp  
 340 345 350

Asp Glu Pro Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 355 360 365

Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 370 375 380

Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Thr Val Thr Ala Gly  
 385 390 395 400

Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser  
 405 410 415

Gly Asn Gln Lys Asn Tyr Leu Thr Trp Tyr Gln Gln Lys Pro Gly Gln  
 420 425 430

Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Thr Arg Glu Ser Gly Val  
 435 440 445

Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr  
 450 455 460

Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn  
 465 470 475 480

Asp Tyr Ser Tyr Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Ile  
 485 490 495

Lys His His His His His His  
 500

<210> 5

<211> 31

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VH BsrGI primer

<400> 5

aggtgtacac tccgatatca aactgcagca g

31

<210> 6

<211> 25

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VL BspEI primer

<400> 6

aatccggatt tcagctccag cttgg

25

<210> 7

<211> 1521

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VHVL aL Ser x 4-7 VHVL

<400> 7

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actcccttga ctactggggc caaggcacca ctctcacagt ctccctcagtc	360
gaagggtgaa gtggagggtc tgggtggaagt ggagggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtagcagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggagggtg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggcgaggc ctggggcttc agtgaagctg tcctgcaagg cttctggcta caccttcaca	840
aactatgggt taagctgggt gaagcagagg cctggacagg tccttgagtg gattggagag	900
gtttatccta gaattggtaa tgcttactac aatgagaagt tcaagggcaa ggccacactg	960
actgcagaca aatcctccag cacagcgtcc atggagctcc gcagcctgac ctctgaggac	1020
tctgcggtct atttctgtgc aagacgggga tcctacgata ctaactacga ctggtacttc	1080
gatgtctggg gccaagggac cacggtcacc gtctcctcag gtggtgggtg ttctggcggc	1140
ggcggctccg gtggtgggtg ttctgagctc gtgatgaccc agactccact ctccctgcct	1200
gtcagtcctg gagatcaagc ctccatctct tgcagatcta gtcagagcct tgtacacagt	1260

aatggaaaca cctattttaca ttggtacctg cagaagccag gccagttctcc aaagctcctg 1320  
 atctacaaag tttccaaccg attttctggg gtcccagaca ggttcagtgg cagtggatca 1380  
 gggacagatt tcacactcaa gatcagcaga gtggaggctg aggatctggg agttttatttc 1440  
 tgctctcaaa gtacacatgt tccgtaçacg ttcggagggg ggaccaagct tgagatcaaa 1500  
 catcatcacc atcatcatta g 1521

<210> 8

<211> 506

<212> PRT

<213> artificial sequence

<220>

<223> CD3 VHVL aL Ser x 4-7 VHVL

<400> 8

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
 145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser

165 170 10 175  
 Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
 180 185 190  
 Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
 195 200 205  
 Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 210 215 220  
 Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240  
 Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255  
 Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala Ser Val Lys Leu Ser Cys  
 260 265 270  
 Lys Ala Ser Gly Tyr Thr Phe Thr Asn Tyr Gly Leu Ser Trp Val Lys  
 275 280 285  
 Gln Arg Pro Gly Gln Val Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg  
 290 295 300  
 Ile Gly Asn Ala Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
 305 310 315 320  
 Thr Ala Asp Lys Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu  
 325 330 335  
 Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr  
 340 345 350  
 Asp Thr Asn Tyr Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr  
 355 360 365  
 Val Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly  
 370 375 380  
 Gly Gly Gly Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro  
 385 390 395 400  
 Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser  
 405 410 415  
 Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys  
 420 425 430  
 Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg Phe  
 435 440 445

Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 450 455 460

Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr Phe  
 465 470 475 480

Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr Lys  
 485 490 495

Leu Glu Ile Lys His His His His His His  
 500 505

<210> 9

<211> 1512

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VHVL aL Ser x 5-10 VHVL

<400> 9

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actcccttga ctactggggc caaggcacca ctctcacagt ctctcagtc	360
gaaggtggaa gtggaggttc tgggtggaagt ggaggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtaggcagg agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggaggtgg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggtaaggc ctgggacttc agtgaagata tcctgcaagg cttctggata cgccttcact	840
aactactggc taggttgggt aaagcagagg cctggacatg gacttgagtg gattggagat	900
attttccctg gaagtggtaa tatccactac aatgagaagt tcaagggcaa agccacactg	960
actgcagaca aatcttcgag cacagcctat atgcagctca gtagcctgac atttgaggac	1020
tctgctgtct atttctgtgc aagactgagg aactgggacg agcctatgga ctactggggc	1080



12

caagggacca cggtcaccgt ctcctcaggt ggtggtggtt ctggcggcgg cggctccggt	1140
ggtggtggtt ctgagctcgt gatgacacag tctccatcct ccctgactgt gacagcagga	1200
gagaagggtca ctatgagctg caagtccagt cagagtctgt taaacagtgg aaatcaaaag	1260
aactacttga cctggtacca gcagaaacca gggcagcctc ctaaactggt gatctactgg	1320
gcatccacta gggaatctgg ggtccctgat cgcttcacag gcagtggatc tggaacagat	1380
ttcactctca ccatcagcag tgtgcaggct gaagacctgg cagtttatta ctgtcagaat	1440
gattatagtt atccgctcac gticggtgct gggaccaagc ttgagatcaa acatcatcac	1500
catcatcatt ag	1512

&lt;210&gt; 10

&lt;211&gt; 503

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 5-10 VHVL

&lt;400&gt; 10

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu<sup>13</sup> Lys Val Thr Met Thr Cys  
 145 150 155 160  
 Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
 165 170 175  
 Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
 180 185 190  
 Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
 195 200 205  
 Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 210 215 220  
 Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240  
 Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255  
 Ser Gly Ala Glu Leu Val Arg Pro Gly Thr Ser Val Lys Ile Ser Cys  
 260 265 270  
 Lys Ala Ser Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys  
 275 280 285  
 Gln Arg Pro Gly His Gly Leu Glu Trp Ile Gly Asp Ile Phe Pro Gly  
 290 295 300  
 Ser Gly Asn Ile His Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
 305 310 315 320  
 Thr Ala Asp Lys Ser Ser Ser Thr Ala Tyr Met Gln Leu Ser Ser Leu  
 325 330 335  
 Thr Phe Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp  
 340 345 350  
 Asp Glu Pro Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 355 360 365  
 Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 370 375 380  
 Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Thr Val Thr Ala Gly  
 385 390 395 400  
 Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser  
 405 410 415  
 Gly Asn Gln Lys Asn Tyr Leu Thr Trp Tyr Gln Gln Lys Pro Gly Gln

14

420

425

430

Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Thr Arg Glu Ser Gly Val  
 435 440 445

Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr  
 450 455 460

Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn  
 465 470 475 480

Asp Tyr Ser Tyr Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Ile  
 485 490 495

Lys His His His His His  
 500

&lt;210&gt; 11

&lt;211&gt; 1485

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 3-1 VHVL

&lt;400&gt; 11

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctctcaggt	360
ggtggtgggt ctggcggcgg cggctccggt ggtggtgggt ctgacattca gctgaccag	420
tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt	480
tcaagtgtaa gttacatgaa ctggtaccag cagaagtcag gcacctcccc caaaagatgg	540
atttatgaca catccaaagt ggcttctgga gtcccttatt gcttcagtgg cagtgggtct	600
gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac	660
tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa	720
tccggagggtg gtggatccga ggtgcagctg ctcgagcagt ctggagctga gctgggtgaaa	780
cctggggcct cagtgaagat atcctgcaag gcttctggat acgccttcac taactactgg	840
ctaggttggg taaagcagag gcctggacat ggacttgagt ggattggaga tcttttcct	900
ggaagtggta atactcacta caatgagagg ttcaggggca aagccacact gactgcagac	960

15

aaatcctcga gcacagcctt tatgcagctc agtagcctga catctgagga ctctgctgtc 1020  
 tattttctgtg caagattgag gaactgggac gaggctatgg actactgggg ccaagggacc 1080  
 acggtcaccg tctcctcagg tgggtggtggt tctggcggcg gcggctccgg tgggtggtggt 1140  
 tctgagctcg tcatgaccca gtctccatct tatcttgctg catctcctgg agaaaccatt 1200  
 actattaatt gcagggcaag taagagcatt agcaaatatt tagcctggta tcaagagaaa 1260  
 cctgggaaaa ctaataagct tcttatctac tctggatcca ctttgcaatc tggaattcca 1320  
 tcaaggttca gtggcagtgg atctggtaca gatttcactc tcaccatcag tagcctggag 1380  
 cctgaagatt ttgcaatgta ttactgtcaa cagcataatg aatatccgta cacgttcgga 1440  
 ggggggacca agcttgagat caaacatcat caccatcatc attag 1485

&lt;210&gt; 12

&lt;211&gt; 494

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 3-1 VHVL

&lt;400&gt; 12

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 115 120 125

Ser Gly Gly Gly Gly Ser Asp Ile Gln Leu Thr Gln Ser Pro Ala Ile

130 135 16 140

Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys Arg Ala Ser  
145 150 155 160

Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser  
165 170 175

Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser Gly Val Pro  
180 185 190

Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile  
195 200 205

Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp  
210 215 220

Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
225 230 235 240

Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala  
245 250 255

Glu Leu Val Lys Pro Gly Ala Ser Val Lys Ile Ser Cys Lys Ala Ser  
260 265 270

Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro  
275 280 285

Gly His Gly Leu Glu Trp Ile Gly Asp Leu Phe Pro Gly Ser Gly Asn  
290 295 300

Thr His Tyr Asn Glu Arg Phe Arg Gly Lys Ala Thr Leu Thr Ala Asp  
305 310 315 320

Lys Ser Ser Ser Thr Ala Phe Met Gln Leu Ser Ser Leu Thr Ser Glu  
325 330 335

Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp Asp Glu Ala  
340 345 350

Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Gly Gly  
355 360 365

Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Glu Leu Val  
370 375 380

Met Thr Gln Ser Pro Ser Tyr Leu Ala Ala Ser Pro Gly Glu Thr Ile  
385 390 395 400

Thr Ile Asn Cys Arg Ala Ser Lys Ser Ile Ser Lys Tyr Leu Ala Trp  
405 410 415



17

Tyr Gln Glu Lys Pro Gly Lys Thr Asn Lys Leu Leu Ile Tyr Ser Gly  
 420 425 430

Ser Thr Leu Gln Ser Gly Ile Pro Ser Arg Phe Ser Gly Ser Gly Ser  
 435 440 445

Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Glu Pro Glu Asp Phe  
 450 455 460

Ala Met Tyr Tyr Cys Gln Gln His Asn Glu Tyr Pro Tyr Thr Phe Gly  
 465 470 475 480

Gly Gly Thr Lys Leu Glu Ile Lys His His His His His His  
 485 490

&lt;210&gt; 13

&lt;211&gt; 1512

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 4-7 VHVL

&lt;400&gt; 13

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctcaggt	360
ggtggtgggt ctggcgggcg cggtccggt ggtggtgggt ctgacattca gctgaccag	420
tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt	480
tcaagtgtaa gttacatgaa ctggtaccag cagaagtcag gcacctcccc caaaagatgg	540
atttatgaca catccaaagt ggcttctgga gtcccttata gcttcagtgg cagtgggtct	600
gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac	660
tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa	720
tccggagggt gtggatccga ggtgcagctg ctcgagcagt ctggagctga gctggcgagg	780
cctggggctt cagtgaagct gtcctgcaag gcttctggct acaccttcac aaactatggt	840
ttaagctggg tgaagcagag gcctggacag gtccttgagt ggattggaga ggtttatcct	900
agaattggta atgcttacta caatgagaag ttcaagggca aggccacact gactgcagac	960

18

```

aaatcctcca gcacagcgtc catggagctc cgcagcctga cctctgagga ctctgcggtc 1020
tattttctgtg caagacgggg atcctacgat actaactacg actggtactt cgatgtctgg 1080
ggccaaggga ccacgggtcac cgtctcctca ggtggtggtg gttctggcgg cggcggctcc 1140
ggtggtggtg gttctgagct cgtgatgacc cagactccac tctccctgcc tgtcagtctt 1200
ggagatcaag cctccatctc ttgcagatct agtcagagcc ttgtacacag taatggaaac 1260
acctattttac attggtacct gcagaagcca ggccagtctc caaagctcct gatctacaaa 1320
gtttccaacc gattttctgg ggtcccagac aggttcagtg gcagtggatc agggacagat 1380
ttcacactca agatcagcag agtggaggct gaggatctgg gagtttattt ctgctctcaa 1440
agtacacatg ttccgtacac gttcggaggg gggaccaagc ttgagatcaa acatcatcac 1500
catcatcatt ag 1512

```

&lt;210&gt; 14

&lt;211&gt; 503

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 4-7 VHVL

&lt;400&gt; 14

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 115 120 125

Ser Gly Gly Gly Gly Ser Asp Ile Gln Leu Thr<sup>19</sup> Gln Ser Pro Ala Ile  
 130 135 140

Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys Arg Ala Ser  
 145 150 155 160

Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser  
 165 170 175

Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser Gly Val Pro  
 180 185 190

Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile  
 195 200 205

Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp  
 210 215 220

Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
 225 230 235 240

Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala  
 245 250 255

Glu Leu Ala Arg Pro Gly Ala Ser Val Lys Leu Ser Cys Lys Ala Ser  
 260 265 270

Gly Tyr Thr Phe Thr Asn Tyr Gly Leu Ser Trp Val Lys Gln Arg Pro  
 275 280 285

Gly Gln Val Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn  
 290 295 300

Ala Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp  
 305 310 315 320

Lys Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu Thr Ser Glu  
 325 330 335

Asp Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr Asp Thr Asn  
 340 345 350

Tyr Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val  
 355 360 365

Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 370 375 380

Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro Val Ser Leu  
 385 390 395 400

Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser Leu Val His



21

```

aacacctatt tacattggta cctgcagaag ccaggccagt ctccaaagct cctgatctac    900
aaagtttcca accgattttc tgggggtcca gacagggttca gtggcagtgg atcagggaca    960
gatttcacac tcaagatcag cagagtggag gctgaggatc tgggagttta tttctgctct    1020
caaagtacac atgttccgta cacgttcgga ggggggacca agcttgagat caaagggtggt    1080
ggtgggttctg gcggcggcgg ctccggtggg ggtgggttctg aggtgcagct gctcgagcag    1140
tctggagctg agctggcgag gcctggggct tcagtgaagc tgtcctgcaa ggcttctggc    1200
tacaccttca caaactatgg tttaagctgg gtgaagcaga ggcctggaca ggtccttgag    1260
tggtattggag aggtttatcc tagaattggg aatgcttact acaatgagaa gttcaagggc    1320
aaggccacac tgactgcaga caaatcctcc agcacagcgt ccatggagct ccgcagcctg    1380
acctctgagg actctgcggt ctatttctgt gcaagacggg gatcctacga tactaactac    1440
gactgggtact tcgatgtctg gggccaaggg accacggtca ccgtctcctc acatcatcac    1500
catcatcatt ag                                                    1512

```

&lt;210&gt; 16

&lt;211&gt; 503

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 4-7 VLVH

&lt;400&gt; 16

```

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala
1           5           10           15

```

```

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr
20           25           30

```

```

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile
35           40           45

```

```

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe
50           55           60

```

```

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr
65           70           75           80

```

```

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys
85           90           95

```

```

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly
100          105          110

```



22

Thr Thr Leu Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 115 120 125  
 Ser Gly Gly Gly Gly Ser Asp Ile Gln Leu Thr Gln Ser Pro Ala Ile  
 130 135 140  
 Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys Arg Ala Ser  
 145 150 155 160  
 Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser  
 165 170 175  
 Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser Gly Val Pro  
 180 185 190  
 Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile  
 195 200 205  
 Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp  
 210 215 220  
 Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
 225 230 235 240  
 Ser Gly Gly Gly Gly Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser  
 245 250 255  
 Leu Pro Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser  
 260 265 270  
 Gln Ser Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu  
 275 280 285  
 Gln Lys Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn  
 290 295 300  
 Arg Phe Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr  
 305 310 315 320  
 Asp Phe Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val  
 325 330 335  
 Tyr Phe Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly  
 340 345 350  
 Thr Lys Leu Glu Ile Lys Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 355 360 365  
 Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu  
 370 375 380

Leu Ala Arg Pro Gly Ala Ser Val Lys Leu <sup>23</sup> Ser Cys Lys Ala Ser Gly  
 385 390 395 400  
 Tyr Thr Phe Thr Asn Tyr Gly Leu Ser Trp Val Lys Gln Arg Pro Gly  
 405 410 415  
 Gln Val Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn Ala  
 420 425 430  
 Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys  
 435 440 445  
 Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu Thr Ser Glu Asp  
 450 455 460  
 Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr Asp Thr Asn Tyr  
 465 470 475 480  
 Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 485 490 495  
 Ser His His His His His His  
 500

&lt;210&gt; 17

&lt;211&gt; 1503

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 5-10 VHVL

&lt;400&gt; 17

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg 60  
 tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg 120  
 cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac 180  
 aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac 240  
 atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat 300  
 gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctcaggt 360  
 ggtggtgggt ctggcggcgg cggtccgggt ggtggtgggt ctgacattca gctgacccag 420  
 tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt 480  
 tcaagtgtaa gttacatgaa ctgggtaccag cagaagtcag gcacctcccc caaaagatgg 540  
 atttatgaca catccaaagt ggcttctgga gtcccttata gcttcagtgg cagtgggtct 600  
 gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac 660

24

tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa	720
tccggaggtg gtggatccga ggtgcagctg ctcgagcagt ctggagctga gctggtaagg	780
cctgggactt cagtgaagat atcctgcaag gcttctggat acgccttcac taactactgg	840
ctaggttggg taaagcagag gcctggacat ggacttgagt ggattggaga tattttccct	900
ggaagtggta atatecacta caatgagaag ttcaagggca aagccacact gactgcagac	960
aaatcttcga gcacagccta tatgcagctc agtagcctga catttgagga ctctgctgtc	1020
tattttctgtg caagactgag gaactgggac gagcctatgg actactgggg ccaagggacc	1080
acggtcaccg tctcctcagg tgggtggtggt tctggcgggc gcggctccgg tgggtggtggt	1140
tctgagctcg tgatgacaca gtctccatcc tccctgactg tgacagcagg agagaaggtc	1200
actatgagct gcaagtccag tcagagtctg ttaaacagtg gaaatcaaaa gaactacttg	1260
acctggtacc agcagaaacc agggcagcct cctaaactgt tgatctactg ggcattccact	1320
agggaatctg gggtcctga tcgcttcaca ggcagtggat ctggaacaga tttcactctc	1380
accatcagca gtgtgcaggc tgaagacctg gcagtttatt actgtcagaa tgattatagt	1440
tatccgctca cgttcgggtgc tgggaccaag cttgagatca aacatcatca ccatcatcat	1500
tag	1503

&lt;210&gt; 18

&lt;211&gt; 500

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 5-10 VHVL

&lt;400&gt; 18

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

25

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110  
 Thr Thr Leu Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 115 120 125  
 Ser Gly Gly Gly Gly Ser Asp Ile Gln Leu Thr Gln Ser Pro Ala Ile  
 130 135 140  
 Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys Arg Ala Ser  
 145 150 155 160  
 Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser  
 165 170 175  
 Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser Gly Val Pro  
 180 185 190  
 Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile  
 195 200 205  
 Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp  
 210 215 220  
 Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
 225 230 235 240  
 Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala  
 245 250 255  
 Glu Leu Val Arg Pro Gly Thr Ser Val Lys Ile Ser Cys Lys Ala Ser  
 260 265 270  
 Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro  
 275 280 285  
 Gly His Gly Leu Glu Trp Ile Gly Asp Ile Phe Pro Gly Ser Gly Asn  
 290 295 300  
 Ile His Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp  
 305 310 315 320  
 Lys Ser Ser Ser Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Phe Glu  
 325 330 335  
 Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp Asp Glu Pro  
 340 345 350  
 Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Gly Gly  
 355 360 365

26

Gly Gly ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Glu Leu Val  
 370 375 380  
 Met Thr Gln Ser Pro Ser Ser Leu Thr Val Thr Ala Gly Glu Lys Val  
 385 390 395 400  
 Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser Gly Asn Gln  
 405 410 415  
 Lys Asn Tyr Leu Thr Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro Lys  
 420 425 430  
 Leu Leu Ile Tyr Trp Ala Ser Thr Arg Glu Ser Gly Val Pro Asp Arg  
 435 440 445  
 Phe Thr Gly ser Gly ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser  
 450 455 460  
 Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn Asp Tyr Ser  
 465 470 475 480  
 Tyr Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Ile Lys His His  
 485 490 495  
 His His His His  
 500

&lt;210&gt; 19

&lt;211&gt; 1503

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 5-10 VLVH

&lt;400&gt; 19

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctcaggt	360
gggtggtggtt ctggcggcgg cggctccggt ggtggtggtt ctgacattca gctgaccag	420
tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt	480
tcaagtgtaa gttacatgaa ctggtaccag cagaagtcag gcacctcccc caaaagatgg	540



27

atttatgaca catccaaagt ggcttctgga gtccttattc gcttcagtgg cagtgggtct 600  
 gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac 660  
 tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa 720  
 tccggagggtg gtggatccga gctcgtgatg acacagtctc catcctccct gactgtgaca 780  
 gcaggagaga aggtcactat gagctgcaag tccagtcaga gtctgttaaa cagtggaaat 840  
 caaaagaact acttgacctg gtaccagcag aaaccagggc agcctcctaa actgttgatc 900  
 tactgggcat ccactagggg atctgggggc cctgatcgct tcacaggcag tggatctgga 960  
 acagatttca ctctcaccat cagcagtgtg caggctgaag acctggcagt ttattactgt 1020  
 cagaatgatt atagttatcc gctcacgttc ggtgctggga ccaagcttga gatcaaaggt 1080  
 ggtggtgggt ctggcggcgg cggctccggt ggtggtgggt ctgagggtgca gctgctcgag 1140  
 cagtctggag ctgagctggt aaggcctggg acttcagtga agatatcctg caaggcttct 1200  
 ggatacgctt tcactaacta ctggctaggt tgggtaaagc agaggcctgg acatggactt 1260  
 gagtggattg gagatatttt ccctggaagt ggtaatatcc actacaatga gaagttcaag 1320  
 ggcaaagcca cactgactgc agacaaatct tcgagcacag cctatatgca gctcagtagc 1380  
 ctgacatttg aggactctgc tgtctatttc tgtgcaagac tgaggaactg ggacgagcct 1440  
 atggactact ggggccaagg gaccacgggc accgtctcct cacatcatca ccatcatcat 1500  
 tag 1503

&lt;210&gt; 20

&lt;211&gt; 500

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 5-10 VLVH

&lt;400&gt; 20

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr

SPOCIN- W0      200410629281 I -

Gly Thr Lys Leu Glu Ile Lys Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 355 360 365

Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala  
 370 375 380

Glu Leu Val Arg Pro Gly Thr Ser Val Lys Ile Ser Cys Lys Ala Ser  
 385 390 395 400

Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro  
 405 410 415

Gly His Gly Leu Glu Trp Ile Gly Asp Ile Phe Pro Gly Ser Gly Asn  
 420 425 430

Ile His Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp  
 435 440 445

Lys Ser Ser Ser Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Phe Glu  
 450 455 460

Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp Asp Glu Pro  
 465 470 475 480

Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser His His  
 485 490 495

His His His His  
 500

<210> 21

<211> 57

<212> DNA

<213> artificial sequence

<220>

<223> 3' CD3 VH GS15 primer

<400> 21

ggagccgccc ccgccagaac caccaccacc tgaggagact gtgagagtgg tgccttg

57

<210> 22

<211> 53

<212> DNA

<213> artificial sequence

53

51

53

49

31

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 5-10 VLGS15REV primer

&lt;400&gt; 26

ggagccgccg ccgccagaac caccaccacc ttgatctca agcttggtcc cag

53

&lt;210&gt; 27

&lt;211&gt; 49

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 5-10 VH GS15 FOR primer

&lt;400&gt; 27

ggcggcggcg gctccggtgg tgggtggttct gaggtgcagc tgctcgagc

49

&lt;210&gt; 28

&lt;211&gt; 53

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 5-10 VHSa1IREV primer

&lt;400&gt; 28

ttttaagtcg acctaagat gatgatgatg atgtgaggag acggtgaccg tgg

53

&lt;210&gt; 29

&lt;211&gt; 1581

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 3-5(VL-VH)xanti-CD3

&lt;400&gt; 29

atgggatgga gctgtatcat cctcttcttg gtagcaacag ctacaggtgt acactccgcg 60

cgcgagctcg tgatgaccca gactccactc tccctgcctg tcagtcttgg agatcaagcc 120

tccatctctt gcagatctag tcagagcctt gtacacagta atggaaacac ctatttacat 180



32

tggtacctgc	agaagccagg	ccagtctcca	aagctcctga	tctacaaagt	ttccaaccga	240
ttttctgggg	tcccagacag	gttcagtggc	agtggatcag	ggacagattt	cacactcaag	300
atcagcagag	tggaggctga	ggatctggga	gtttatttct	gctctcaaag	tacacatggt	360
ccgtacacgt	tcggaggggg	gaccaagctt	gagatcaaag	gtggtggtgg	ttctggcggc	420
ggcggctccg	gtggtggtgg	ttctgaggtg	cagctgctcg	agcagtctgg	agctgagctg	480
gtaaggcctg	ggacttcagt	gaagctgtcc	tgcaaggctt	ctggctacac	cttcacaagc	540
tatggtttaa	gctgggtgaa	gcagagaact	ggacagggcc	ttgagtggat	tggagaggtt	600
tatcctagaa	ttggtaatgc	ttactacaat	gagaagttca	agggcaaggc	cacactgact	660
gcagacaaat	cctccagcac	agcgtccatg	gagctccgca	gcctgacatc	tgaggactct	720
gcggtctatt	tctgtgcaag	acggggatcc	tacggtagta	actacgactg	gtacttcgat	780
gtctggggcc	aagggaccac	ggtcaccgtc	tcctccggag	gtggtggatc	cgatatcaaa	840
ctgcagcagt	caggggctga	actggcaaga	cctggggcct	cagtgaagat	gtcctgcaag	900
acttctggct	acacctttac	taggtacacg	atgcactggg	taaaacagag	gcctggacag	960
ggctctggaat	ggattggata	cattaatcct	agccgtgggt	atactaatta	caatcagaag	1020
ttcaaggaca	aggccacatt	gactacagac	aaatcctcca	gcacagccta	catgcaactg	1080
agcagcctga	catctgagga	ctctgcagtc	tattactgtg	caagatatta	tgatgatcat	1140
tactgccttg	actactgggg	ccaaggcacc	actctcacag	tctcctcagt	cgaagggtgga	1200
agtggaggtt	ctggtggaag	tggaggttca	ggtggagtcg	acgacattca	gctgacccag	1260
tctccagcaa	tcatgtctgc	atctccaggg	gagaaggcca	ccatgacctg	cagagccagt	1320
tcaagtgtaa	gttacatgaa	ctggtaccag	cagaagtcag	gcacctcccc	caaaagatgg	1380
atztatgaca	catccaaagt	ggcttctgga	gtcccttata	gcttcagtgg	cagtgggtct	1440
gggacctcat	actctctcac	aatcagcagc	atggaggctg	aagatgctgc	cacttattac	1500
tgccaacagt	ggagtagtaa	cccgtcacg	ttcggtgctg	ggaccaagct	ggagctgaaa	1560
catcatcacc	atcatcatta	g				1581

&lt;210&gt; 30

&lt;211&gt; 526

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 3-5(VL-VH)xanti-CD3

&lt;400&gt; 30

Met Gly Trp Ser Cys Ile Ile Leu Phe Leu Val Ala Thr Ala Thr Gly  
 1 5 10 15

Val His Ser Ala Arg Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu  
 20 25 30 33

Pro Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln  
 35 40 45

Ser Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln  
 50 55 60

Lys Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg  
 65 70 75 80

Phe Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp  
 85 90 95

Phe Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr  
 100 105 110

Phe Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr  
 115 120 125

Lys Leu Glu Ile Lys Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly  
 130 135 140

Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu  
 145 150 155 160

Val Arg Pro Gly Thr Ser Val Lys Leu Ser Cys Lys Ala Ser Gly Tyr  
 165 170 175

Thr Phe Thr Ser Tyr Gly Leu Ser Trp Val Lys Gln Arg Thr Gly Gln  
 180 185 190

Gly Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn Ala Tyr  
 195 200 205

Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser  
 210 215 220

Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Ser  
 225 230 235 240

Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr Gly Ser Asn Tyr Asp  
 245 250 255

Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 260 265 270

Gly Gly Gly Gly Ser Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu  
 275 280 285

Ala Arg Pro Gly Ala Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr

290 295 34 300  
 Thr Phe Thr Arg Tyr Thr Met His Trp Val Lys Gln Arg Pro Gly Gln  
 305 310 315 320  
 Gly Leu Glu Trp Ile Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn  
 325 330 335  
 Tyr Asn Gln Lys Phe Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser  
 340 345 350  
 Ser Ser Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser  
 355 360 365  
 Ala Val Tyr Tyr Cys Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp  
 370 375 380  
 Tyr Trp Gly Gln Gly Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly  
 385 390 395 400  
 Ser Gly Gly Ser Gly Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile  
 405 410 415  
 Gln Leu Thr Gln Ser Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys  
 420 425 430  
 Val Thr Met Thr Cys Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp  
 435 440 445  
 Tyr Gln Gln Lys Ser Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr  
 450 455 460  
 Ser Lys Val Ala Ser Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser  
 465 470 475 480  
 Gly Thr Ser Tyr Ser Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala  
 485 490 495  
 Ala Thr Tyr Tyr Cys Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly  
 500 505 510  
 Ala Gly Thr Lys Leu Glu Leu Lys His His His His His His  
 515 520 525

&lt;210&gt; 31

&lt;211&gt; 40

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

35

&lt;220&gt;

&lt;223&gt; Me81 primer

&lt;400&gt; 31

ggatgcgcgc gagctcgtga tgacccagac tccactctcc

40

&lt;210&gt; 32

&lt;211&gt; 60

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; Me83 primer

&lt;400&gt; 32

ggttctggcg gcggcggctc cggtggtggt ggttctgagg tgcagctgct cgacagtctg

60

&lt;210&gt; 33

&lt;211&gt; 41

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; Me84 primer

&lt;400&gt; 33

gtgctccgga ggagacggtg accgtggtcc cttggcccca g

41

&lt;210&gt; 34

&lt;211&gt; 53

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; Me90 primer

&lt;400&gt; 34

ccggagccgc cgccgccaga accaccacca cttttgatct caagcttggt ccc

53

&lt;210&gt; 35

&lt;211&gt; 1548

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 3-1(VLVH)xanti-CD3

&lt;400&gt; 35

atgggatgga gctgtatcat cctcttcttg gtagcaacag ctacaggtgt acactccgag	60
ctcgtcatga cccagtctcc atcttatctt gctgcatctc ctggagaaac cattactatt	120
aattgcaggg caagtaagag cattagcaaa tatttagcct ggtatcaaga gaaacctggg	180
aaaactaata agcttcttat ctactctgga tccactttgc aatctggaat tccatcaagg	240
ttcagtggca gtggatctgg tacagatttc actctcacca tcagtagcct ggagcctgaa	300
gattttgcaa tgtattactg tcaacagcat aatgaatata cgtacacgtt cggagggggg	360
accaagcttg agatcaaagg tgggtggtggt tctggcggcg gcggctccgg tgggtggtggt	420
tctgaggtgc agctgctcga gcagtctgga gctgagctgg tgaaacctgg ggcctcagtg	480
aagatatact gcaaggcttc tggatacgcc ttcactaact actggctagg ttgggtaaag	540
cagaggcctg gacatggact tgagtggatt ggagatcttt tccctggaag tggtaatact	600
cactacaatg agagggtcag gggcaaagcc aactgactg cagacaaatc ctcgagcaca	660
gccttttatgc agctcagtag cctgacatct gaggactctg ctgtctatct ctgtgcaaga	720
ttgaggaact gggacgaggg tatggactac tggggccaag ggaccacggt caccgtctcc	780
tccggaggtg gtggatccga tatcaaactg cagcagtcag gggctgaact ggcaagacct	840
ggggcctcag tgaagatgtc ctgcaagact tctggctaca cctttactag gtacacgatg	900
cactgggtaa aacagaggcc tggacagggt ctggaatgga ttggatacat taatcctagc	960
cgtgggttata ctaattacaa tcagaagttc aaggacaagg ccacattgac tacagacaaa	1020
tcctccagca cagcctacat gcaactgagc agcctgacat ctgaggactc tgcagtctat	1080
tactgtgcaa gatattatga tgatcattac tgccttgact actggggcca aggcaccact	1140
ctcacagtct cctcagtcga aggtggaagt ggaggttctg gtggaagtgg aggttcaggt	1200
ggagtcgacg acattcagct gacccagtct ccagcaatca tgtctgcatc tccaggggag	1260
aaggtcacca tgacctgag agccagttca agtgtaagtt acatgaactg gtaccagcag	1320
aagtcaggca cctcccccaa aagatggatt tatgacacat ccaaagtggc ttctggagtc	1380
ccttatcgct tcagtggcag tgggtctggg acctcatact ctctcacaat cagcagcatg	1440
gaggctgaag atgctgccac ttattactgc caacagtgga gtagtaacct gctcacgttc	1500
ggtgctggga ccaagctgga gctgaaacat catcaccatc atcattag	1548

&lt;210&gt; 36

&lt;211&gt; 515

&lt;212&gt; PRT

&lt;213&gt; artificial sequence



&lt;220&gt;

&lt;223&gt; 3-1(VLVH)xanti-CD3

&lt;400&gt; 36

Met Gly Trp Ser Cys Ile Ile Leu Phe Leu Val Ala Thr Ala Thr Gly  
 1 5 10 15

Val His Ser Glu Leu Val Met Thr Gln Ser Pro Ser Tyr Leu Ala Ala  
 20 25 30

Ser Pro Gly Glu Thr Ile Thr Ile Asn Cys Arg Ala Ser Lys Ser Ile  
 35 40 45

Ser Lys Tyr Leu Ala Trp Tyr Gln Glu Lys Pro Gly Lys Thr Asn Lys  
 50 55 60

Leu Leu Ile Tyr Ser Gly Ser Thr Leu Gln Ser Gly Ile Pro Ser Arg  
 65 70 75 80

Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser  
 85 90 95

Leu Glu Pro Glu Asp Phe Ala Met Tyr Tyr Cys Gln Gln His Asn Glu  
 100 105 110

Tyr Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys Gly Gly  
 115 120 125

Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Glu Val Gln  
 130 135 140

Leu Leu Glu Gln Ser Gly Ala Glu Leu Val Lys Pro Gly Ala Ser Val  
 145 150 155 160

Lys Ile Ser Cys Lys Ala Ser Gly Tyr Ala Phe Thr Asn Tyr Trp Leu  
 165 170 175

Gly Trp Val Lys Gln Arg Pro Gly His Gly Leu Glu Trp Ile Gly Asp  
 180 185 190

Leu Phe Pro Gly Ser Gly Asn Thr His Tyr Asn Glu Arg Phe Arg Gly  
 195 200 205

Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser Ser Thr Ala Phe Met Gln  
 210 215 220

Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg  
 225 230 235 240

Leu Arg Asn Trp Asp Glu Ala Met Asp Tyr Trp Gly Gln Gly Thr Thr

245 250 38 255  
 val Thr val ser ser Gly Gly Gly Gly ser Asp Ile Lys Leu Gln Gln  
 260 265 270  
 ser Gly Ala Glu Leu Ala Arg Pro Gly Ala ser val Lys Met ser Cys  
 275 280 285  
 Lys Thr ser Gly Tyr Thr Phe Thr Arg Tyr Thr Met His Trp val Lys  
 290 295 300  
 Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile Gly Tyr Ile Asn Pro ser  
 305 310 315 320  
 Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe Lys Asp Lys Ala Thr Leu  
 325 330 335  
 Thr Thr Asp Lys ser ser ser Thr Ala Tyr Met Gln Leu ser ser Leu  
 340 345 350  
 Thr ser Glu Asp ser Ala val Tyr Tyr Cys Ala Arg Tyr Tyr Asp Asp  
 355 360 365  
 His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly Thr Thr Leu Thr val ser  
 370 375 380  
 ser val Glu Gly Gly ser Gly Gly ser Gly Gly ser Gly Gly ser Gly  
 385 390 395 400  
 Gly val Asp Asp Ile Gln Leu Thr Gln ser Pro Ala Ile Met ser Ala  
 405 410 415  
 ser Pro Gly Glu Lys val Thr Met Thr Cys Arg Ala ser ser ser val  
 420 425 430  
 ser Tyr Met Asn Trp Tyr Gln Gln Lys ser Gly Thr ser Pro Lys Arg  
 435 440 445  
 Trp Ile Tyr Asp Thr ser Lys val Ala ser Gly val Pro Tyr Arg Phe  
 450 455 460  
 ser Gly ser Gly ser Gly Thr ser Tyr ser Leu Thr Ile ser ser Met  
 465 470 475 480  
 Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp ser ser Asn  
 485 490 495  
 Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys His His His  
 500 505 510  
 His His His  
 515

&lt;210&gt; 37

&lt;211&gt; 52

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; Me91a primer

&lt;400&gt; 37

ggattgtaca ctccgagctc gtcattgaccc agtctccatc ttatcttgct gc 52

&lt;210&gt; 38

&lt;211&gt; 1566

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 4-1(VLVH)xanti-CD3

&lt;400&gt; 38

atgggatgga gctgtatcat cctcttcttg gtagcaacag ctacaggtgt acactccgag	60
ctcgtgatga cacagtctcc atcctccctg agtgtgtcag caggagagaa ggtcactatg	120
agctgcaagt ccagtcagag tctgttaaac agtggaaatc aaaagaacta cttggcctgg	180
taccagcaga aaccagggca gcctcctaaa ctgttgatct acggggcatc cactagggaa	240
tctgggggtcc ctgatcgctt cacaggcagt ggatctggaa cagatttcac tctcaccatc	300
agcagtgtgc aggctgaaga cctggcagtt tattactgtc agaatgatta tagttatccg	360
tacacgttcg gaggggggac caagcttgag atcaaagggtg gtggtgggttc tggcggcggc	420
ggctccgggtg gtggtgggttc tgagggtgcag ctgctcgagc agtctggagc tgagctggta	480
aggcctggga cttcagtga gatatcctgc aaggcttctg gatacgctt cactaactac	540
tggctagggtt gggttaagca gaggcctgga catggacttg aatgggttgg agatattttc	600
cctggaagtg gtaatgctca ctacaatgag aagttcaagg gcaaagccac actgactgca	660
gacaagtcct cgtacacagc ctatatgcag ctcatgagcc tgacatctga ggactctgct	720
gtctattttct gtgcaagatt gcggaactgg gacgaggcta tggactactg gggccaaggg	780
accacgggtca ccgtctcctc cggagggtggg ggatccgata tcaaactgca gcagtcaggg	840
gctgaactgg caagacctgg ggcctcagtg aagatgtcct gcaagacttc tggctacacc	900
tttactagggt acacgatgca ctgggtaaaa cagaggcctg gacaggggtct ggaatggatt	960
ggatacatta atcctagccg tggttatact aattacaatc agaagttcaa ggacaaggcc	1020

40

acattgacta cagacaaatc ctccagcaca gcctacatgc aactgagcag cctgacatct 1080  
gaggactctg cagtctatta ctgtgcaaga tattatgatg atcattactg ccttgactac 1140  
tggggccaag gcaccactct cacagtctcc tcagtcgaag gtggaagtgg aggttctggt 1200  
ggaagtggag gttcaggtgg agtcgacgac attcagctga ccagttctcc agcaatcatg 1260  
tctgcatctc caggggagaa ggtcaccatg acctgcagag ccagttcaag tgtaagttac 1320  
atgaactggg accagcagaa gtcaggcacc tcccccaaaa gatggattta tgacacatcc 1380  
aaagtggctt ctggagtccc ttatcgcttc agtggcagtg ggtctgggac ctcataactct 1440  
ctcacaatca gcagcatgga ggctgaagat gctgccactt attactgcca acagtggagt 1500  
agtaacccgc tcacgttcgg tgctgggacc aagctggagc tgaaacatca tcaccatcat 1560  
cattag 1566

&lt;210&gt; 39

&lt;211&gt; 521

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 4-1(VLVH)xanti-CD3

&lt;400&gt; 39

Met Gly Trp Ser Cys Ile Ile Leu Phe Leu Val Ala Thr Ala Thr Gly  
1 5 10 15

Val His Ser Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Ser Val  
20 25 30

Ser Ala Gly Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu  
35 40 45

Leu Asn Ser Gly Asn Gln Lys Asn Tyr Leu Ala Trp Tyr Gln Gln Lys  
50 55 60

Pro Gly Gln Pro Pro Lys Leu Leu Ile Tyr Gly Ala Ser Thr Arg Glu  
65 70 75 80

Ser Gly Val Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe  
85 90 95

Thr Leu Thr Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr  
100 105 110

Cys Gln Asn Asp Tyr Ser Tyr Pro Tyr Thr Phe Gly Gly Gly Thr Lys  
115 120 125

Leu Glu Ile Lys Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly  
 130 135 140

Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Val  
 145 150 155 160

Arg Pro Gly Thr Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Ala  
 165 170 175

Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro Gly His Gly  
 180 185 190

Leu Glu Trp Val Gly Asp Ile Phe Pro Gly Ser Gly Asn Ala His Tyr  
 195 200 205

Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser  
 210 215 220

Tyr Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala  
 225 230 235 240

Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp Asp Glu Ala Met Asp Tyr  
 245 250 255

Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Gly Gly Gly Gly Ser  
 260 265 270

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 275 280 285

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 290 295 300

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 305 310 315 320

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 325 330 335

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 340 345 350

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 355 360 365

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 370 375 380

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 385 390 395 400

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser



<220>

<223> 4-7(VL-VH)xanti CD3

<400> 41

atgggatgga	gctgtatcat	cctcttcttg	gtagcaacag	ctacagggtgt	acactccgcg	60
cgcgagctcg	tgatgacca	gactccactc	tccctgcctg	tcagtcttgg	agatcaagcc	120
tccatctctt	gcagatctag	tcagagcctt	gtacacagta	atggaaacac	ctattttacat	180

43

tggtacctgc agaagccagg ccagtctcca aagctcctga tctacaaagt ttccaaccga	240
ttttctgggg tcccagacag gttcagtggc agtggatcag ggacagattt cacactcaag	300
atcagcagag tggaggctga ggatctggga gtttatttct gctctcaaag tacacatggt	360
ccgtacacgt tcggaggggg gaccaagctt gagatcaaag gtggtggtgg ttctggcggc	420
ggcggctccg gtggtggtgg ttctgaggtg cagctgctcg agcagtctgg agctgagctg	480
gcgaggcctg gggcttcagt gaagctgtcc tgcaaggctt ctggctacac cttcacaac	540
tatggtttaa gctgggtgaa gcagaggcct ggacaggtcc ttgagtggat tggagagggt	600
tatcctagaa ttggtaatgc ttactacaat gagaagttca agggcaaggc cacactgact	660
gcagacaaat cctccagcac agcgtccatg gagctccgca gcctgacctc tgaggactct	720
gcggtctatt tctgtgcaag acggggatcc tacgatacta actacgactg gtacttcgat	780
gtctggggcc aagggaaccac ggtcaccgtc tcctccggag gtggtggatc cgatatcaaa	840
ctgcagcagt caggggctga actggcaaga cctggggcct cagtgaagat gtcctgcaag	900
acttctggct acacctttac taggtacacg atgcactggg taaaacagag gcctggacag	960
ggtctggaat ggattggata cattaatcct agccgtgggt atactaatta caatcagaag	1020
ttcaaggaca aggccacatt gactacagac aaatcctcca gcacagccta catgcaactg	1080
agcagcctga catctgagga ctctgcagtc tattactgtg caagatatta tgatgatcat	1140
tactgccttg actactgggg ccaaggcacc actctcacag tctcctcagt cgaagggtga	1200
agtggagggt ctggtggaag tggagggttca ggtggagtcg acgacattca gctgaccag	1260
tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt	1320
tcaagtgtaa gttacatgaa ctggtaccag cagaagtcag gcacctccc caaaagatgg	1380
atttatgaca catccaaagt ggcttctgga gtcccttatc gcttcagtgg cagtgggtct	1440
gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac	1500
tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa	1560
catcatcacc atcatcatta g	1581

&lt;210&gt; 42

&lt;211&gt; 526

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; 4-7(VL-VH)xanti CD3

&lt;400&gt; 42

Met	Gly	Trp	Ser	Cys	Ile	Ile	Leu	Phe	Leu	Val	Ala	Thr	Ala	Thr	Gly
1				5			10							15	

44

Val His Ser Ala Arg Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu  
 20 25 30

Pro Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln  
 35 40 45

Ser Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln  
 50 55 60

Lys Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg  
 65 70 75 80

Phe Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp  
 85 90 95

Phe Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr  
 100 105 110

Phe Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr  
 115 120 125

Lys Leu Glu Ile Lys Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly  
 130 135 140

Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu  
 145 150 155 160

Ala Arg Pro Gly Ala Ser Val Lys Leu Ser Cys Lys Ala Ser Gly Tyr  
 165 170 175

Thr Phe Thr Asn Tyr Gly Leu Ser Trp Val Lys Gln Arg Pro Gly Gln  
 180 185 190

Val Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn Ala Tyr  
 195 200 205

Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser  
 210 215 220

Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Ser  
 225 230 235 240

Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr Asp Thr Asn Tyr Asp  
 245 250 255

Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 260 265 270

Gly Gly Gly Gly Ser Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu  
 275 280 285

Ala Arg Pro Gly Ala Ser Val Lys Met Ser Cys<sup>45</sup> Lys Thr Ser Gly Tyr  
 290 295 300

Thr Phe Thr Arg Tyr Thr Met His Trp Val Lys Gln Arg Pro Gly Gln  
 305 310 315 320

Gly Leu Glu Trp Ile Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn  
 325 330 335

Tyr Asn Gln Lys Phe Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser  
 340 345 350

Ser Ser Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser  
 355 360 365

Ala Val Tyr Tyr Cys Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp  
 370 375 380

Tyr Trp Gly Gln Gly Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly  
 385 390 395 400

Ser Gly Gly Ser Gly Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile  
 405 410 415

Gln Leu Thr Gln Ser Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys  
 420 425 430

Val Thr Met Thr Cys Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp  
 435 440 445

Tyr Gln Gln Lys Ser Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr  
 450 455 460

Ser Lys Val Ala Ser Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser  
 465 470 475 480

Gly Thr Ser Tyr Ser Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala  
 485 490 495

Ala Thr Tyr Tyr Cys Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly  
 500 505 510

Ala Gly Thr Lys Leu Glu Leu Lys His His His His His His  
 515 520 525

<210> 43

<211> 1566

<212> DNA

<213> artificial sequence

<400> 43

<210> 44

<211> 521

<212> PRT

<213> artificial sequence



&lt;220&gt;

&lt;223&gt; 5-10(VLVH)xanti-CD3

&lt;400&gt; 44

Met Gly Trp ser Cys Ile Ile Leu Phe Leu Val Ala Thr Ala Thr Gly  
 1 5 10 15  
 Val His Ser Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Thr Val  
 20 25 30  
 Thr Ala Gly Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu  
 35 40 45  
 Leu Asn Ser Gly Asn Gln Lys Asn Tyr Leu Thr Trp Tyr Gln Gln Lys  
 50 55 60  
 Pro Gly Gln Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Thr Arg Glu  
 65 70 75 80  
 Ser Gly Val Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe  
 85 90 95  
 Thr Leu Thr Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr  
 100 105 110  
 Cys Gln Asn Asp Tyr Ser Tyr Pro Leu Thr Phe Gly Ala Gly Thr Lys  
 115 120 125  
 Leu Glu Ile Lys Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly  
 130 135 140  
 Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Val  
 145 150 155 160  
 Arg Pro Gly Thr Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Ala  
 165 170 175  
 Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro Gly His Gly  
 180 185 190  
 Leu Glu Trp Ile Gly Asp Ile Phe Pro Gly Ser Gly Asn Ile His Tyr  
 195 200 205  
 Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser  
 210 215 220  
 Ser Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Phe Glu Asp Ser Ala  
 225 230 235 240  
 Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp Asp Glu Pro Met Asp Tyr

245 250 48 255  
 Trp Gly Gln Gly Thr Thr Val Thr Val ser ser Gly Gly Gly Gly Ser  
 260 265 270  
 Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 275 280 285  
 Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 290 295 300  
 Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 305 310 315 320  
 Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 325 330 335  
 Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 340 345 350  
 Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 355 360 365  
 Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 370 375 380  
 Thr Thr Leu Thr Val ser ser Val Glu Gly Gly ser Gly Gly Ser Gly  
 385 390 395 400  
 Gly ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 405 410 415  
 Pro Ala Ile Met ser Ala ser Pro Gly Glu Lys Val Thr Met Thr Cys  
 420 425 430  
 Arg Ala Ser ser ser Val ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
 435 440 445  
 Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
 450 455 460  
 Gly Val Pro Tyr Arg Phe Ser Gly ser Gly ser Gly Thr Ser Tyr Ser  
 465 470 475 480  
 Leu Thr Ile Ser ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 485 490 495  
 Gln Gln Trp Ser ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 500 505 510  
 Glu Leu Lys His His His His His His  
 515 520

&lt;210&gt; 45

&lt;211&gt; 1494

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 3-1 VHVL

&lt;400&gt; 45

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctctcagtc	360
gaaggtggaa gtggagggttc tgggtggaagt ggagggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtagcagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggagggtgg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggtgaaac ctggggcctc agtgaagata tcctgcaagg cttctggata cgccttcact	840
aactactggc taggttgggt aaagcagagg cctggacatg gacttgagtg gattggagat	900
cttttcctg gaagtggtaa tactcactac aatgagaggt tcaggggcaa agccacactg	960
actgcagaca aatcctcgag cacagccttt atgcagctca gtagcctgac atctgaggac	1020
tctgctgtct atttctgtgc aagattgagg aactgggacg aggctatgga ctactggggc	1080
caagggacca cggtcaccgt ctctcaggt ggtggtggtt ctggcggcgg cggctccggt	1140
ggtggtggtt ctgagctcgt catgacctag tctccatctt atcttgctgc atctcctgga	1200
gaaaccatta ctattaattg cagggaagat aagagcatta gcaaataatt agcctgggtat	1260
caagagaaac ctgggaaaac taataagctt cttatctact ctggatccac tttgcaatct	1320
ggaattccat caaggttcag tggcagtgga tctggtacag atttcactct caccatcagt	1380
agcctggagc ctgaagattt tgcaatgtat tactgtcaac agcataatga atatccgtac	1440
acgttcggag gggggaccaa gcttgagatc aaacatcatc accatcatca ttag	1494

&lt;210&gt; 46

50

&lt;211&gt; 497

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 3-1 VHVL

&lt;400&gt; 46

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
165 170 175

Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
180 185 190

Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
195 200 205

Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
210 215 220

Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240  
 Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255  
 Ser Gly Ala Glu Leu Val Lys Pro Gly Ala Ser Val Lys Ile Ser Cys  
 260 265 270  
 Lys Ala Ser Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys  
 275 280 285  
 Gln Arg Pro Gly His Gly Leu Glu Trp Ile Gly Asp Leu Phe Pro Gly  
 290 295 300  
 Ser Gly Asn Thr His Tyr Asn Glu Arg Phe Arg Gly Lys Ala Thr Leu  
 305 310 315 320  
 Thr Ala Asp Lys Ser Ser Ser Thr Ala Phe Met Gln Leu Ser Ser Leu  
 325 330 335  
 Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp  
 340 345 350  
 Asp Glu Ala Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 355 360 365  
 Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 370 375 380  
 Glu Leu Val Met Thr Gln Ser Pro Ser Tyr Leu Ala Ala Ser Pro Gly  
 385 390 395 400  
 Glu Thr Ile Thr Ile Asn Cys Arg Ala Ser Lys Ser Ile Ser Lys Tyr  
 405 410 415  
 Leu Ala Trp Tyr Gln Glu Lys Pro Gly Lys Thr Asn Lys Leu Leu Ile  
 420 425 430  
 Tyr Ser Gly Ser Thr Leu Gln Ser Gly Ile Pro Ser Arg Phe Ser Gly  
 435 440 445  
 Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Glu Pro  
 450 455 460  
 Glu Asp Phe Ala Met Tyr Tyr Cys Gln Gln His Asn Glu Tyr Pro Tyr  
 465 470 475 480  
 Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys His His His His His  
 485 490 495



His

&lt;210&gt; 47

&lt;211&gt; 1494

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 3-1 VHVL

&lt;400&gt; 47

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actcccttga ctactggggc caaggcacca ctctcacagt ctcctcagtc	360
gaagggtggaa gtggaggttc tgggtggaagt ggaggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtagcagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggaggtgg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggtgaaac ctggggcctc agtgaagata tcctgcaagg cttctggata cgccttcact	840
aactactggc taggttgggt aaagcagagg cctggacatg gacttgagtg gattggagat	900
cttttccctg gaagtggtaa tactcactac aatgagaggt tcaggggcaa agccacactg	960
actgcagaca aatcctcgag cacagccttt atgcagctca gtagcctgac atctgaggac	1020
tctgctgtct atttctgtgc aagattgagg aactgggacg aggctatgga ctactggggc	1080
caagggacca cggtcaccgt ctcctcaggt ggtgggtggt ctggcggcgg cggctccggt	1140
ggtgggtggt ctgagctcgt catgacccag tctccatctt atcttgctgc atctcctgga	1200
gaaaccatta ctattaattg cagggcaagt aagagcatta gcaaataatt agcctgggtat	1260
caagagaaac ctgggaaaac taataagctt cttatctact ctggatccac tttgcaatct	1320
ggaattccat caagggttcag tggcagtgga tctggtacag atttcactct caccatcagt	1380
agcctggagc ctgaagatct tgcaatgtat tactgtcaac agcataatga atatccgtac	1440
acgttcggag gggggaccaa gcttgagatc aaacatcatc accatcatca ttag	1494

&lt;210&gt; 48

&lt;211&gt; 497

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 3-1 VHVL

&lt;400&gt; 48

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr Trp Gly Gln Gly  
100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
165 170 175

Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
180 185 190

Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
195 200 205

54

Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 210 215 220

Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240

Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255

Ser Gly Ala Glu Leu Val Lys Pro Gly Ala Ser Val Lys Ile Ser Cys  
 260 265 270

Lys Ala Ser Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys  
 275 280 285

Gln Arg Pro Gly His Gly Leu Glu Trp Ile Gly Asp Leu Phe Pro Gly  
 290 295 300

Ser Gly Asn Thr His Tyr Asn Glu Arg Phe Arg Gly Lys Ala Thr Leu  
 305 310 315 320

Thr Ala Asp Lys Ser Ser Ser Thr Ala Phe Met Gln Leu Ser Ser Leu  
 325 330 335

Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp  
 340 345 350

Asp Glu Ala Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 355 360 365

Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 370 375 380

Glu Leu Val Met Thr Gln Ser Pro Ser Tyr Leu Ala Ala Ser Pro Gly  
 385 390 395 400

Glu Thr Ile Thr Ile Asn Cys Arg Ala Ser Lys Ser Ile Ser Lys Tyr  
 405 410 415

Leu Ala Trp Tyr Gln Glu Lys Pro Gly Lys Thr Asn Lys Leu Leu Ile  
 420 425 430

Tyr Ser Gly Ser Thr Leu Gln Ser Gly Ile Pro Ser Arg Phe Ser Gly  
 435 440 445

Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Glu Pro  
 450 455 460

Glu Asp Phe Ala Met Tyr Tyr Cys Gln Gln His Asn Glu Tyr Pro Tyr  
 465 470 475 480

Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys His His His His His  
 485 490 495 55

His

<210> 49

<211> 1521

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VHVL aL x 3-5 VHVL

<400> 49

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctcagtc	360
gaagggtgaa gtggaggttc tgggtggaagt ggaggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tgggtaccagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggaggtgg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggtaaggc ctgggacttc agtgaagctg tcctgcaagg cttctggcta caccttcaca	840
agctatgggt taagctgggt gaagcagaga actggacagg gccttgagtg gattggagag	900
gtttatccta gaattggtaa tgcttactac aatgagaagt tcaagggcaa ggccacactg	960
actgcagaca aatcctccag cacagcgtcc atggagctcc gcagcctgac atctgaggac	1020
tctgcggtct atttctgtgc aagacgggga tcctacggta gtaactacga ctggtacttc	1080
gatgtctggg gccaagggac cacggtcacc gtctcctcag gtggtggtgg ttctggcggc	1140
ggcggctccg gtggtggtgg ttctgagctc gtgatgacct agactccact ctccctgcct	1200
gtcagtcttg gagatcaagc ctccatctct tgcagatcta gtcagagcct tgtacacagt	1260
aatggaaaca cctatttaca ttggtacctg cagaagccag gccagtctcc aaagctcctg	1320
atctacaaag tttccaaccg attttctggg gtcccagaca ggttcagtg cagtggatca	1380

56

gggacagatt tcacactcaa gatcagcaga gtggaggctg aggatctggg agttttatttc 1440  
 tgctctcaaa gtacacatgt tccgtacacg ttcggagggg ggaccaagct tgagatcaaa 1500  
 catcatcacc atcatcatta g 1521

&lt;210&gt; 50

&lt;211&gt; 506

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 3-5 VHVL

&lt;400&gt; 50

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
 145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
 165 170 175

Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
 180 185 190



Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
 195 200 205  
 Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 210 215 220  
 Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240  
 Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255  
 Ser Gly Ala Glu Leu Val Arg Pro Gly Thr Ser Val Lys Leu Ser Cys  
 260 265 270  
 Lys Ala Ser Gly Tyr Thr Phe Thr Ser Tyr Gly Leu Ser Trp Val Lys  
 275 280 285  
 Gln Arg Thr Gly Gln Gly Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg  
 290 295 300  
 Ile Gly Asn Ala Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
 305 310 315 320  
 Thr Ala Asp Lys Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu  
 325 330 335  
 Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr  
 340 345 350  
 Gly Ser Asn Tyr Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr  
 355 360 365  
 Val Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Ser Gly  
 370 375 380  
 Gly Gly Gly Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro  
 385 390 395 400  
 Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser  
 405 410 415  
 Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys  
 420 425 430  
 Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg Phe  
 435 440 445  
 Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 450 455 460

58

Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr Phe  
465 470 475 480

Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr Lys  
485 490 495

Leu Glu Ile Lys His His His His His His  
500 505

&lt;210&gt; 51

&lt;211&gt; 1521

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 3-5 VHVL

&lt;400&gt; 51

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actcccttga ctactggggc caaggcacca ctctcacagt ctccctcagtc	360
gaagggtggaa gtggagggttc tgggtggaagt ggagggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tgggtaccagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggagggtg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggtaaggc ctgggacttc agtgaagctg tcctgcaagg cttctggcta caccttcaca	840
agctatgggt taagctgggt gaagcagaga actggacagg gccttgagtg gattggagag	900
gtttatccta gaattggtaa tgcttactac aatgagaagt tcaagggcaa ggccacactg	960
actgcagaca aatcctccag cacagcgtcc atggagctcc gcagcctgac atctgaggac	1020
tctgcggtct atttctgtgc aagacgggga tcctacggta gtaactacga ctggtacttc	1080
gatgtctggg gccaagggac cacggtcacc gtctcctcag gtggtgggtg ttctggcggc	1140
ggcggctccg gtggtgggtg ttctgagctc gtgatgaccc agactccact ctccctgcct	1200
gtcagtcttg gagatcaagc ctccatctct tgcagatcta gtcagagcct tgtacacagt	1260

59

aatggaaaca cctattttaca ttggtacctg cagaagccag gccagtctcc aaagctcctg 1320  
 atctacaaag tttccaaccg attttctggg gtcccagaca ggttcagtgg cagtggatca 1380  
 gggacagatt tcacactcaa gatcagcaga gtggaggctg aggatctggg agttttatttc 1440  
 tgctctcaaa gtacacatgt tccgtacacg ttcggagggg ggaccaagct tgagatcaaa 1500  
 catcatcacc atcatcatta g 1521

&lt;210&gt; 52

&lt;211&gt; 506

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 3-5 VHVL

&lt;400&gt; 52

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 115 120 125

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
 145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser

165 170 60 175

Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
180 185 190

Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
195 200 205

Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
210 215 220

Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
225 230 235 240

Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
245 250 255

Ser Gly Ala Glu Leu Val Arg Pro Gly Thr Ser Val Lys Leu Ser Cys  
260 265 270

Lys Ala Ser Gly Tyr Thr Phe Thr Ser Tyr Gly Leu Ser Trp Val Lys  
275 280 285

Gln Arg Thr Gly Gln Gly Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg  
290 295 300

Ile Gly Asn Ala Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
305 310 315 320

Thr Ala Asp Lys Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu  
325 330 335

Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr  
340 345 350

Gly Ser Asn Tyr Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr  
355 360 365

Val Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Ser Gly  
370 375 380

Gly Gly Gly Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro  
385 390 395 400

Val Ser Leu Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser  
405 410 415

Leu Val His Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys  
420 425 430

Pro Gly Gln Ser Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg Phe  
435 440 445

61

Ser Gly Val Pro Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe  
 450 455 460

Thr Leu Lys Ile Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr Phe  
 465 470 475 480

Cys Ser Gln Ser Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr Lys  
 485 490 495

Leu Glu Ile Lys His His His His His His  
 500 505

<210> 53

<211> 1512

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VHVL stL x 3-5 VHVL

<400> 53

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctcaggt	360
ggtggtggtt ctggcggcgg cggctccggt ggtggtggtt ctgacattca gctgaccag	420
tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt	480
tcaagtgtaa gttacatgaa ctggtaccag cagaagtcag gcacctcccc caaaagatgg	540
atztatgaca catccaaagt ggcttctgga gtcccttata gcttcagtgg cagtgggtct	600
gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac	660
tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa	720
tccggagggtg gtggatccga ggtgcagctg ctcgagcagt ctggagctga gctggtaagg	780
cctgggactt cagtgaagct gtcctgcaag gcttctggct acaccttcac aagctatggt	840
ttaagctggg tgaagcagag aactggacag ggccttgagt ggattggaga ggtttatcct	900
agaattggta atgcttacta caatgagaag ttcaagggtca aggccacact gactgcagac	960
aaatcctcca gcacagcgtc catggagctc cgcagcctga catctgagga ctctgcggtc	1020
tatttctgtg caagacgggg atcctacggt agtaactacg actggtactt cgatgtctgg	1080



62

ggccaaggga ccacgggtcac cgtctcctca ggtggtggtg gttctggcgg cggcggctcc	1140
ggtggtggtg gttctgagct cgtgatgacc cagactccac tctccctgcc tgtcagtctt	1200
ggagatcaag cctccatctc ttgcagatct agtcagagcc ttgtacacag taatggaaac	1260
acctatttac attggtacct gcagaagcca ggccagtctc caaagctcct gatctacaaa	1320
gtttccaacc gattttctgg ggtcccagac aggttcagtg gcagtggatc agggacagat	1380
ttcacactca agatcagcag agtggaggct gaggatctgg gagtttattt ctgctctcaa	1440
agtacacatg ttccgtacac gttcggaggg gggaccaagc ttgagatcaa acatcatcac	1500
catcatcatt ag	1512

&lt;210&gt; 54

&lt;211&gt; 503

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 3-5 VHVL

&lt;400&gt; 54

Asp	Ile	Lys	Leu	Gln	Gln	Ser	Gly	Ala	Glu	Leu	Ala	Arg	Pro	Gly	Ala
1				5					10					15	

Ser	Val	Lys	Met	Ser	Cys	Lys	Thr	Ser	Gly	Tyr	Thr	Phe	Thr	Arg	Tyr
			20					25					30		

Thr	Met	His	Trp	Val	Lys	Gln	Arg	Pro	Gly	Gln	Gly	Leu	Glu	Trp	Ile
		35					40					45			

Gly	Tyr	Ile	Asn	Pro	Ser	Arg	Gly	Tyr	Thr	Asn	Tyr	Asn	Gln	Lys	Phe
	50					55					60				

Lys	Asp	Lys	Ala	Thr	Leu	Thr	Thr	Asp	Lys	Ser	Ser	Ser	Thr	Ala	Tyr
65					70					75				80	

Met	Gln	Leu	Ser	Ser	Leu	Thr	Ser	Glu	Asp	Ser	Ala	Val	Tyr	Tyr	Cys
			85						90					95	

Ala	Arg	Tyr	Tyr	Asp	Asp	His	Tyr	Cys	Leu	Asp	Tyr	Trp	Gly	Gln	Gly
			100					105					110		

Thr	Thr	Leu	Thr	Val	Ser	Ser	Gly	Gly	Gly	Gly	Ser	Gly	Gly	Gly	Gly
		115					120					125			

Ser	Gly	Gly	Gly	Gly	Ser	Asp	Ile	Gln	Leu	Thr	Gln	Ser	Pro	Ala	Ile
	130					135					140				

Met<sup>63</sup> Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys Arg Ala Ser  
 145 150 155 160

Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser  
 165 170 175

Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser Gly Val Pro  
 180 185 190

Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile  
 195 200 205

Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp  
 210 215 220

Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
 225 230 235 240

Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala  
 245 250 255

Glu Leu Val Arg Pro Gly Thr Ser Val Lys Leu Ser Cys Lys Ala Ser  
 260 265 270

Gly Tyr Thr Phe Thr Ser Tyr Gly Leu Ser Trp Val Lys Gln Arg Thr  
 275 280 285

Gly Gln Gly Leu Glu Trp Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn  
 290 295 300

Ala Tyr Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp  
 305 310 315 320

Lys Ser Ser Ser Thr Ala Ser Met Glu Leu Arg Ser Leu Thr Ser Glu  
 325 330 335

Asp Ser Ala Val Tyr Phe Cys Ala Arg Arg Gly Ser Tyr Gly Ser Asn  
 340 345 350

Tyr Asp Trp Tyr Phe Asp Val Trp Gly Gln Gly Thr Thr Val Thr Val  
 355 360 365

Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 370 375 380

Ser Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro Val Ser Leu  
 385 390 395 400

Gly Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser Leu Val His  
 405 410 415

Ser Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys Pro Gly Gln

64

420

425

430

Ser Pro Lys<sub>435</sub> Leu Leu Ile Tyr Lys<sub>440</sub> Val Ser Asn Arg Phe<sub>445</sub> Ser Gly Val

Pro Asp Arg Phe Ser Gly Ser<sub>455</sub> Gly Ser Gly Thr Asp<sub>460</sub> Phe Thr Leu Lys

Ile Ser Arg Val Glu Ala<sub>470</sub> Glu Asp Leu Gly Val<sub>475</sub> Tyr Phe Cys Ser Gln<sub>480</sub>

Ser Thr His Val Pro<sub>485</sub> Tyr Thr Phe Gly Gly<sub>490</sub> Gly Thr Lys Leu Glu<sub>495</sub> Ile

Lys His His His His His His  
500

&lt;210&gt; 55

&lt;211&gt; 1512

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL x 4-1 VHVL

&lt;400&gt; 55

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctctcagtc	360
gaaggtggaa gtggagggtc tgggtggaagt ggagggtcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaagggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtagcagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggagggtg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780
ctggtaaggc ctgggacttc agtgaagata tcctgcaagg cttctggata cgccttcact	840
aactactggc taggttgggt taagcagagg cctggacatg gacttgaatg gggttgagat	900
attttccctg gaagtggtaa tgctcactac aatgagaagt tcaagggcaa agccacactg	960

65

actgcagaca agtcctcgta cacagcctat atgcagctca gtagcctgac atctgaggac 1020  
 tctgctgtct atttctgtgc aagattgcgg aactgggacg aggctatgga ctactggggc 1080  
 caagggacca cggtcaccgt ctctcaggt ggtggtggtt ctggcggcgg cggctccggt 1140  
 ggtggtggtt ctgagctcgt gatgacacag tctccatcct ccctgagtgt gtcagcagga 1200  
 gagaaggtca ctatgagctg caagtccagt cagagtctgt taaacagtgg aaatcaaaag 1260  
 aactacttgg cctggtacca gcagaaacca gggcagcctc ctaaactgtt gatctacggg 1320  
 gcatccacta gggaaatctgg ggtccctgat cgcttcacag gcagtggatc tggaacagat 1380  
 ttcactctca ccatcagcag tgtgcaggct gaagacctgg cagtttatta ctgtcagaat 1440  
 gattatagtt atccgtacac gttcggaggg gggaccaagc ttgagatcaa acatcatcac 1500  
 catcatcatt ag 1512

<210> 56  
 <211> 503  
 <212> PRT  
 <213> artificial sequence

<220>

<223> CD3 VHVL aL x 4-1 VHVL

<400> 56

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 115 120 125

66

Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 130 135 140

Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
 145 150 155 160

Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
 165 170 175

Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
 180 185 190

Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
 195 200 205

Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 210 215 220

Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240

Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255

Ser Gly Ala Glu Leu Val Arg Pro Gly Thr Ser Val Lys Ile Ser Cys  
 260 265 270

Lys Ala Ser Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys  
 275 280 285

Gln Arg Pro Gly His Gly Leu Glu Trp Val Gly Asp Ile Phe Pro Gly  
 290 295 300

Ser Gly Asn Ala His Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
 305 310 315 320

Thr Ala Asp Lys Ser Ser Tyr Thr Ala Tyr Met Gln Leu Ser Ser Leu  
 325 330 335

Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp  
 340 345 350

Asp Glu Ala Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 355 360 365

Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 370 375 380

Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Ser Val Ser Ala Gly  
 385 390 395 400

Glu Lys Val Thr Met Ser Cys Lys Ser Ser<sup>67</sup> Gln Ser Leu Leu Asn Ser  
 405 410 415  
 Gly Asn Gln Lys Asn Tyr Leu Ala Trp Tyr Gln Gln Lys Pro Gly Gln  
 420 425 430  
 Pro Pro Lys Leu Leu Ile Tyr Gly Ala Ser Thr Arg Glu Ser Gly Val  
 435 440 445  
 Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr  
 450 455 460  
 Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn  
 465 470 475 480  
 Asp Tyr Ser Tyr Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile  
 485 490 495  
 Lys His His His His His His  
 500

&lt;210&gt; 57

&lt;211&gt; 1512

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 4-1 VHVL

&lt;400&gt; 57

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actcccttga ctactggggc caaggcacca ctctcacagt ctctcagtc	360
gaaggtggaa gtggaggttc tgggtggaagt ggaggttcag gtggagtcga cgacattcag	420
ctgacccagt ctccagcaat catgtctgca tctccagggg agaaggtcac catgacctgc	480
agagccagtt caagtgtaag ttacatgaac tggtaccagc agaagtcagg cacctcccc	540
aaaagatgga tttatgacac atccaaagtg gcttctggag tcccttatcg cttcagtggc	600
agtgggtctg ggacctcata ctctctcaca atcagcagca tggaggctga agatgctgcc	660
acttattact gccaacagtg gagtagtaac ccgctcacgt tcggtgctgg gaccaagctg	720
gagctgaaat ccggaggtgg tggatccgag gtgcagctgc tcgagcagtc tggagctgag	780



68

```

ctggttaaggc ctgggacttc agtgaagata tcctgcaagg cttctggata cgccttcact      840
aactactggc taggttgggt taagcagagg cctggacatg gacttgaatg ggttggagat      900
attttccctg gaagtggtaa tgctcactac aatgagaagt tcaagggcaa agccacactg      960
actgcagaca agtcctcgta cacagcctat atgcagctca gtagcctgac atctgaggac     1020
tctgctgtct atttctgtgc aagattgcgg aactgggacg aggctatgga ctactggggc     1080
caagggacca cggtcaccgt ctctcaggt ggtggtggtt ctggcggcgg cggtccggt      1140
ggtggtggtt ctgagctcgt gatgacacag tctccatcct ccctgagtgt gtcagcagga     1200
gagaagggtca ctatgagctg caagtccagt cagagtctgt taaacagtgg aaatcaaaag     1260
aactacttgg cctggtacca gcagaaacca gggcagcctc ctaaactggt gatctacggg     1320
gcatccacta gggaatctgg ggtccctgat cgcttcacag gcagtggatc tggaacagat     1380
ttcactctca ccatcagcag tgtgcaggct gaagacctgg cagtttatta ctgtcagaat     1440
gattatagtt atccgtacac gttcggaggg gggaccaagc ttgagatcaa acatcatcac     1500
catcatcatt ag                                                         1512

```

&lt;210&gt; 58

&lt;211&gt; 503

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL aL Ser x 4-1 VHVL

&lt;400&gt; 58

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr Trp Gly Gln Gly  
100 105 110

Thr Thr Leu Thr Val Ser Ser Val Glu Gly Gly Ser Gly Gly Ser Gly  
 115 120 125  
 Gly Ser Gly Gly Ser Gly Gly Val Asp Asp Ile Gln Leu Thr Gln Ser  
 130 135 140  
 Pro Ala Ile Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys  
 145 150 155 160  
 Arg Ala Ser Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser  
 165 170 175  
 Gly Thr Ser Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser  
 180 185 190  
 Gly Val Pro Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser  
 195 200 205  
 Leu Thr Ile Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys  
 210 215 220  
 Gln Gln Trp Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu  
 225 230 235 240  
 Glu Leu Lys Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln  
 245 250 255  
 Ser Gly Ala Glu Leu Val Arg Pro Gly Thr Ser Val Lys Ile Ser Cys  
 260 265 270  
 Lys Ala Ser Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys  
 275 280 285  
 Gln Arg Pro Gly His Gly Leu Glu Trp Val Gly Asp Ile Phe Pro Gly  
 290 295 300  
 Ser Gly Asn Ala His Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu  
 305 310 315 320  
 Thr Ala Asp Lys Ser Ser Tyr Thr Ala Tyr Met Gln Leu Ser Ser Leu  
 325 330 335  
 Thr Ser Glu Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp  
 340 345 350  
 Asp Glu Ala Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser  
 355 360 365  
 Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
 370 375 380

70

Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Ser Val Ser Ala Gly  
385 390 395 400

Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser  
405 410 415

Gly Asn Gln Lys Asn Tyr Leu Ala Trp Tyr Gln Gln Lys Pro Gly Gln  
420 425 430

Pro Pro Lys Leu Leu Ile Tyr Gly Ala Ser Thr Arg Glu Ser Gly Val  
435 440 445

Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr  
450 455 460

Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn  
465 470 475 480

Asp Tyr Ser Tyr Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile  
485 490 495

Lys His His His His His His  
500

<210> 59

<211> 1503

<212> DNA

<213> artificial sequence

<220>

<223> CD3 VHVL stL x 4-1 VHVL

<400> 59  
gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg 60  
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg 120  
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac 180  
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac 240  
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat 300  
gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctcaggt 360  
ggtggtggtt ctggcggcgg cggtccggt ggtggtggtt ctgacattca gctgaccag 420  
tctccagcaa tcatgtctgc atctccaggg gagaagggtca ccatgacctg cagagccagt 480  
tcaagtgtaa gttacatgaa ctggtaccag cagaagtcag gcacctcccc caaaagatgg 540  
atttatgaca catcaaagt ggcttctgga gtcccttata gcttcagtgg cagtgggtct 600  
gggacctcat actctctcac aatcagcagc atggaggctg aagatgctgc cacttattac 660

71

tgccaacagt ggagtagtaa cccgctcacg ttcggtgctg ggaccaagct ggagctgaaa 720  
 tccggagggtg gtggatccga ggtgcagctg ctcgagcagt ctggagctga gctggtaagg 780  
 cctgggactt cagtgaagat atcctgcaag gcttctggat acgccttcac taactactgg 840  
 ctaggttggg ttaagcagag gcctggacat ggacttgaat gggttggaga tattttccct 900  
 ggaagtggta atgctcacta caatgagaag ttcaagggca aagccacact gactgcagac 960  
 aagtcctcgt acacagccta tatgcagctc agtagcctga catctgagga ctctgctgtc 1020  
 tatttctgtg caagattgcy gaactgggac gaggctatgg actactgggg ccaagggacc 1080  
 acggtcaccg tctcctcagg tgggtggtggt tctggcggcg gcggctccgg tgggtggtggt 1140  
 tctgagctcg tgatgacaca gtctccatcc tccctgagtg tgtcagcagg agagaaggtc 1200  
 actatgagct gcaagtccag tcagagtctg ttaaacagtg gaaatcaaaa gaactacttg 1260  
 gcctgggtacc agcagaaacc agggcagcct cctaaactgt tgatctacgg ggcatccact 1320  
 agggaatctg gggtcctga tcgcttcaca ggcagtggat ctggaacaga tttcactctc 1380  
 accatcagca gtgtgcaggc tgaagacctg gcagtttatt actgtcagaa tgattatagt 1440  
 tatccgtaca cgttcggagg ggggaccaag cttgagatca aacatcatca ccatcatcat 1500  
 tag 1503

&lt;210&gt; 60

&lt;211&gt; 500

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; CD3 VHVL stL x 4-1 VHVL

&lt;400&gt; 60

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys

85 90 72 95  
 Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110  
 Thr Thr Leu Thr Val Ser Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly  
 115 120 125  
 Ser Gly Gly Gly Gly Ser Asp Ile Gln Leu Thr Gln Ser Pro Ala Ile  
 130 135 140  
 Met Ser Ala Ser Pro Gly Glu Lys Val Thr Met Thr Cys Arg Ala Ser  
 145 150 155 160  
 Ser Ser Val Ser Tyr Met Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser  
 165 170 175  
 Pro Lys Arg Trp Ile Tyr Asp Thr Ser Lys Val Ala Ser Gly Val Pro  
 180 185 190  
 Tyr Arg Phe Ser Gly Ser Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile  
 195 200 205  
 Ser Ser Met Glu Ala Glu Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp  
 210 215 220  
 Ser Ser Asn Pro Leu Thr Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
 225 230 235 240  
 Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Leu Glu Gln Ser Gly Ala  
 245 250 255  
 Glu Leu Val Arg Pro Gly Thr Ser Val Lys Ile Ser Cys Lys Ala Ser  
 260 265 270  
 Gly Tyr Ala Phe Thr Asn Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro  
 275 280 285  
 Gly His Gly Leu Glu Trp Val Gly Asp Ile Phe Pro Gly Ser Gly Asn  
 290 295 300  
 Ala His Tyr Asn Glu Lys Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp  
 305 310 315 320  
 Lys Ser Ser Tyr Thr Ala Tyr Met Gln Leu Ser Ser Leu Thr Ser Glu  
 325 330 335  
 Asp Ser Ala Val Tyr Phe Cys Ala Arg Leu Arg Asn Trp Asp Glu Ala  
 340 345 350  
 Met Asp Tyr Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser Gly Gly  
 355 360 365

Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Glu Leu Val  
 370 375 380

Met Thr Gln Ser Pro Ser Ser Leu Ser Val Ser Ala Gly Glu Lys Val  
 385 390 395 400

Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser Gly Asn Gln  
 405 410 415

Lys Asn Tyr Leu Ala Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro Lys  
 420 425 430

Leu Leu Ile Tyr Gly Ala Ser Thr Arg Glu Ser Gly Val Pro Asp Arg  
 435 440 445

Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser  
 450 455 460

Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn Asp Tyr Ser  
 465 470 475 480

Tyr Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys His His  
 485 490 495

His His His His  
 500

<210> 61

<211> 10

<212> PRT

<213> artificial sequence

<220>

<223> CDRH3 M1 mutant

<400> 61

His Tyr Asp Asp His Tyr Cys Leu Asp Tyr  
 1 5 10

<210> 62

<211> 10

<212> PRT

<213> artificial sequence

<220>



<223> CDRH3 M4 mutant

<400> 62

Tyr Ser Asp Asp His Tyr Cys Leu Asp Tyr  
1 5 10

<210> 63

<211> 10

<212> PRT

<213> artificial sequence

<220>

<223> CDRH3 M7 mutant

<400> 63

Tyr Tyr Asp Ala His Tyr Cys Leu Asp Tyr  
1 5 10

<210> 64

<211> 10

<212> PRT

<213> artificial sequence

<220>

<223> CDRH3 M9 mutant

<400> 64

Tyr Tyr Asp Asp Gln Tyr Cys Leu Asp Tyr  
1 5 10

<210> 65

<211> 10

<212> PRT

<213> artificial sequence

<220>

<223> CDRH3 M10 mutant

<400> 65

Tyr Tyr Asp Asp Pro Tyr Cys Leu Asp Tyr  
1 5 10

75

<210> 66  
<211> 10  
<212> PRT  
<213> artificial sequence

&lt;220&gt;

&lt;223&gt; CDRH3 M11 mutant

&lt;400&gt; 66

Tyr Phe Asn Asp His Tyr Cys Leu Asp Tyr  
1 5 10

<210> 67  
<211> 10  
<212> PRT  
<213> artificial sequence

&lt;220&gt;

&lt;223&gt; CDRH3 M13 mutant

&lt;400&gt; 67

Tyr Tyr Asn Asp Gln Tyr Cys Leu Asp Tyr  
1 5 10

<210> 68  
<211> 10  
<212> PRT  
<213> artificial sequence

&lt;220&gt;

&lt;223&gt; CDRH3 M20 mutant

&lt;400&gt; 68

Tyr His Asp Asp Pro Tyr Cys Leu Asp Tyr  
1 5 10

<210> 69  
<211> 10  
<212> PRT  
<213> artificial sequence

&lt;220&gt;

&lt;223&gt; CDRH3 M76 mutant

&lt;400&gt; 69

Tyr Tyr Asp Asp Asn Tyr Cys Leu Asp Tyr  
 1 5 10

&lt;210&gt; 70

&lt;211&gt; 18

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; original linker

&lt;400&gt; 70

Val Glu Gly Gly Ser Gly Gly Ser Gly Gly Ser Gly Gly  
 1 5 10 15

Val Asp

&lt;210&gt; 71

&lt;211&gt; 357

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; anti-CD3 VH

<400> 71  
 gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg 60  
 tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg 120  
 cctggacagg gtctggaatg gattggatac attaatccta gccgtgggta tactaattac 180  
 aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac 240  
 atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat 300  
 gatgatcatt actgccttga ctactggggc caaggcacca ctctcacagt ctcctca 357

&lt;210&gt; 72

&lt;211&gt; 119

&lt;212&gt; PRT

77

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; anti-CD3VH

&lt;400&gt; 72

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala  
 1 5 10 15

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr  
 20 25 30

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile  
 35 40 45

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe  
 50 55 60

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr  
 65 70 75 80

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys  
 85 90 95

Ala Arg Tyr Tyr Asp Asp His Tyr Cys Leu Asp Tyr Trp Gly Gln Gly  
 100 105 110

Thr Thr Leu Thr Val Ser Ser  
 115

&lt;210&gt; 73

&lt;211&gt; 318

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; anti-CD3 VL

&lt;400&gt; 73

gacattcagc tgaccagtc tccagcaatc atgtctgcat ctccagggga gaaggtcacc 60

atgacctgca gagccagttc aagtgttaagt tacatgaact ggtaccagca gaagtcaggc 120

acctcccca aaagatggat ttatgacaca tccaaagtgg cttctggagt cccttatcgc 180

ttcagtggca gtgggtctgg gacctcatac tctctcacia tcagcagcat ggaggctgaa 240

gatgctgcca cttattactg ccaacagtgg agtagtaacc cgctcacgtt cggtgctggg 300

accaagctgg agctgaaa 318

78

&lt;210&gt; 74

&lt;211&gt; 106

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; anti-CD3 VL

&lt;400&gt; 74

Asp Ile Gln Leu Thr Gln Ser Pro Ala Ile Met Ser Ala Ser Pro Gly  
 1 5 10 15

Glu Lys Val Thr Met Thr Cys Arg Ala Ser Ser Ser Val Ser Tyr Met  
 20 25 30

Asn Trp Tyr Gln Gln Lys Ser Gly Thr Ser Pro Lys Arg Trp Ile Tyr  
 35 40 45

Asp Thr Ser Lys Val Ala Ser Gly Val Pro Tyr Arg Phe Ser Gly Ser  
 50 55 60

Gly Ser Gly Thr Ser Tyr Ser Leu Thr Ile Ser Ser Met Glu Ala Glu  
 65 70 75 80

Asp Ala Ala Thr Tyr Tyr Cys Gln Gln Trp Ser Ser Asn Pro Leu Thr  
 85 90 95

Phe Gly Ala Gly Thr Lys Leu Glu Leu Lys  
 100 105

&lt;210&gt; 75

&lt;211&gt; 10

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; VH CDR1 anti-CD3

&lt;400&gt; 75

Gly Tyr Thr Phe Thr Arg Tyr Thr Met His  
 1 5 10

&lt;210&gt; 76

&lt;211&gt; 357

&lt;212&gt; . DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; vH anti-CD3 cys-&gt;ser

&lt;400&gt; 76

gatatcaaac tgcagcagtc aggggctgaa ctggcaagac ctggggcctc agtgaagatg	60
tcctgcaaga cttctggcta cacctttact aggtacacga tgcactgggt aaaacagagg	120
cctggacagg gtctggaatg gattggatac attaatccta gccgtgggtta tactaattac	180
aatcagaagt tcaaggacaa ggccacattg actacagaca aatcctccag cacagcctac	240
atgcaactga gcagcctgac atctgaggac tctgcagtct attactgtgc aagatattat	300
gatgatcatt actcccttga ctactggggc caaggcacca ctctcacagt ctcctca	357

&lt;210&gt; 77

&lt;211&gt; 119

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; vH anti-CD3 cys-&gt;ser

&lt;400&gt; 77

Asp Ile Lys Leu Gln Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly Ala	1	5	10	15
---	---	---	----	----

Ser Val Lys Met Ser Cys Lys Thr Ser Gly Tyr Thr Phe Thr Arg Tyr	20	25	30
---	----	----	----

Thr Met His Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile	35	40	45
---	----	----	----

Gly Tyr Ile Asn Pro Ser Arg Gly Tyr Thr Asn Tyr Asn Gln Lys Phe	50	55	60
---	----	----	----

Lys Asp Lys Ala Thr Leu Thr Thr Asp Lys Ser Ser Ser Thr Ala Tyr	65	70	75	80
---	----	----	----	----

Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Tyr Cys	85	90	95
---	----	----	----

Ala Arg Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr Trp Gly Gln Gly	100	105	110
---	-----	-----	-----

Thr Thr Leu Thr Val Ser Ser
-----------------------------



80

115

&lt;210&gt; 78

&lt;211&gt; 10

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; VH CDR3 anti-CD3 cys-&gt;ser

&lt;400&gt; 78

Tyr Tyr Asp Asp His Tyr Ser Leu Asp Tyr  
1 5 10

&lt;210&gt; 79

&lt;211&gt; 360

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 3-1 VH

&lt;400&gt; 79

gaggtgcagc tgctcgagca gtctggagct gagctggtga aacctggggc ctcagtgaag	60
atatcctgca aggcttctgg atacgccttc actaactact ggctagggtg ggtaaagcag	120
aggcctggac atggacttga gtggattgga gatcttttcc ctggaagtgg taatactcac	180
tacaatgaga ggttcagggg caaagccaca ctgactgcag acaaatcctc gagcacagcc	240
tttatgcagc tcagtagcct gacatctgag gactctgctg tctatttctg tgcaagattg	300
aggaactggg acgaggctat ggactactgg ggccaaggga ccacggtcac cgtctcctca	360

&lt;210&gt; 80

&lt;211&gt; 120

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 3-1 VH

&lt;400&gt; 80

Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Val Lys Pro Gly  
1 5 10 15

81

Ala Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Ala Phe Thr Asn  
20 25 30

Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro Gly His Gly Leu Glu Trp  
35 40 45

Ile Gly Asp Leu Phe Pro Gly Ser Gly Asn Thr His Tyr Asn Glu Arg  
50 55 60

Phe Arg Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser Ser Thr Ala  
65 70 75 80

Phe Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Phe  
85 90 95

Cys Ala Arg Leu Arg Asn Trp Asp Glu Ala Met Asp Tyr Trp Gly Gln  
100 105 110

Gly Thr Thr Val Thr Val Ser Ser  
115 120

<210> 81

<211> 321

<212> DNA

<213> artificial sequence

<220>

<223> EpCAM 3-1 VL

<400> 81

gagctcgtca tgaccagtc tccatcttat cttgctgcat ctctggaga aaccattact 60  
attaattgca gggcaagtaa gagcattagc aaatatttag cctgggtatca agagaaacct 120  
gggaaaacta ataagcttct tatctactct ggatccactt tgcaatctgg aattccatca 180  
aggttcagtg gcagtggatc tggtagatg ttcactctca ccatcagtag cctggagcct 240  
gaagattttg caatgtatta ctgtcaacag cataatgaat atccgtacac gttcggaggg 300  
gggaccaagc ttgagatcaa a 321

<210> 82

<211> 107

<212> PRT

<213> artificial sequence

<220>

82

&lt;223&gt; EpCAM 3-1 VL

&lt;400&gt; 82

Glu Leu Val Met Thr Gln Ser Pro Ser Tyr Leu Ala Ala Ser Pro Gly  
 1 5 10 15

Glu Thr Ile Thr Ile Asn Cys Arg Ala Ser Lys Ser Ile Ser Lys Tyr  
 20 25 30

Leu Ala Trp Tyr Gln Glu Lys Pro Gly Lys Thr Asn Lys Leu Leu Ile  
 35 40 45

Tyr Ser Gly Ser Thr Leu Gln Ser Gly Ile Pro Ser Arg Phe Ser Gly  
 50 55 60

Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Glu Pro  
 65 70 75 80

Glu Asp Phe Ala Met Tyr Tyr Cys Gln Gln His Asn Glu Tyr Pro Tyr  
 85 90 95

Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys  
 100 105

&lt;210&gt; 83

&lt;211&gt; 372

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 3-5 VH

&lt;400&gt; 83

gaggtgcagc tgctcgagca gtctggagct gagctggtaa ggcctgggac ttcagtgaag 60  
 ctgtcctgca aggcttctgg ctacaccttc acaagctatg gtttaagctg ggtgaagcag 120  
 agaactggac agggccttga gtggattgga gaggtttatc ctagaattgg taatgcttac 180  
 tacaatgaga agttcaaggg caaggccaca ctgactgcag acaaatcctc cagcacagcg 240  
 tccatggagc tccgcagcct gacatctgag gactctgcgg tctatttctg tgcaagacgg 300  
 ggatcctacg gtagtaacta cgactggtac ttcgatgtct ggggcccaagg gaccacggtc 360  
 accgtctcct ca 372

&lt;210&gt; 84

&lt;211&gt; 124

&lt;212&gt; PRT

83

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 3-5 VH

&lt;400&gt; 84

Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Val Arg Pro Gly  
 1 5 10 15

Thr Ser Val Lys Leu Ser Cys Lys Ala Ser Gly Tyr Thr Phe Thr Ser  
 20 25 30

Tyr Gly Leu Ser Trp Val Lys Gln Arg Thr Gly Gln Gly Leu Glu Trp  
 35 40 45

Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn Ala Tyr Tyr Asn Glu Lys  
 50 55 60

Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser Ser Thr Ala  
 65 70 75 80

Ser Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Phe  
 85 90 95

Cys Ala Arg Arg Gly Ser Tyr Gly Ser Asn Tyr Asp Trp Tyr Phe Asp  
 100 105 110

Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser  
 115 120

&lt;210&gt; 85

&lt;211&gt; 336

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 3-5 VL

&lt;400&gt; 85

gagctcgtga tgaccagac tccactctcc ctgcctgtca gtcttggaga tcaagcctcc 60

atctcttgca gatctagtca gagccttgta cacagtaatg gaaacaccta ttacattgg 120

tacctgcaga agccaggcca gtctccaaag ctctgatct acaaagtttc caaccgattt 180

tctgggggtcc cagacagggtt cagtggcagt ggatcaggga cagatttcac actcaagatc 240

agcagagtgg aggctgagga tctgggagtt tatttctgct ctcaaagtac acatgttccg 300

tacacgttcg gaggggggac caagcttgag atcaaa 336

<210> 86  
 <211> 112  
 <212> PRT  
 <213> artificial sequence

<220>

<223> EpCAM 3-5 VL

<400> 86

Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro Val Ser Leu Gly  
 1 5 10 15

Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser Leu Val His Ser  
 20 25 30

Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys Pro Gly Gln Ser  
 35 40 45

Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg Phe Ser Gly Val Pro  
 50 55 60

Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Lys Ile  
 65 70 75 80

Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr Phe Cys Ser Gln Ser  
 85 90 95

Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys  
 100 105 110

<210> 87  
 <211> 360  
 <212> DNA  
 <213> artificial sequence

<220>

<223> EpCAM 4-1 VH

<400> 87

gaggtgcagc tgctcgagca gtctggagct gagctggtaa ggcctgggac ttcagtgaag	60
atatcctgca aggcttctgg atacgccttc actaactact ggctagggttg ggttaagcag	120
aggcctggac atggacttga atgggttgga gatattttcc ctggaagtgg taatgctcac	180
tacaatgaga agttcaaggg caaagccaca ctgactgcag acaagtcctc gtacacagcc	240
tatatgcagc tcagtagcct gacatctgag gactctgctg tctattttctg tgcaagattg	300

85

cggaactggg acgaggctat ggactactgg ggccaaggga ccacgggtcac cgtctcctca 360

&lt;210&gt; 88

&lt;211&gt; 120

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 4-1 VH

&lt;400&gt; 88

Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Val Arg Pro Gly  
1 5 10 15Thr Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Ala Phe Thr Asn  
20 25 30Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro Gly His Gly Leu Glu Trp  
35 40 45Val Gly Asp Ile Phe Pro Gly Ser Gly Asn Ala His Tyr Asn Glu Lys  
50 55 60Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser Tyr Thr Ala  
65 70 75 80Tyr Met Gln Leu Ser Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Phe  
85 90 95Cys Ala Arg Leu Arg Asn Trp Asp Glu Ala Met Asp Tyr Trp Gly Gln  
100 105 110Gly Thr Thr Val Thr Val Ser Ser  
115 120

&lt;210&gt; 89

&lt;211&gt; 339

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 4-1 VL

&lt;400&gt; 89

gagctcgtga tgacacagtc tccatcctcc ctgagtgtgt cagcaggaga gaaggtcact 60



86  
atgagctgca agtccagtca gagtctgtta aacagtggaa atcaaaagaa ctacttggcc 120  
tggtaccagc agaaaccagg gcagcctcct aaactgttga tctacggggc atccactagg 180  
gaatctgggg tccctgatcg cttcacaggc agtggatctg gaacagattt cactctcacc 240  
atcagcagtg tgcaggctga agacctggca gtttattact gtcagaatga ttatagttat 300  
ccgtacacgt tcggaggggg gaccaagctt gagatcaaa 339

<210> 90

<211> 113

<212> PRT

<213> artificial sequence

<220>

<223> EpCAM 4-1 VL

<400> 90

Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Ser Val Ser Ala Gly  
1 5 10 15

Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser  
20 25 30

Gly Asn Gln Lys Asn Tyr Leu Ala Trp Tyr Gln Gln Lys Pro Gly Gln  
35 40 45

Pro Pro Lys Leu Leu Ile Tyr Gly Ala Ser Thr Arg Glu Ser Gly Val  
50 55 60

Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr  
65 70 75 80

Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn  
85 90 95

Asp Tyr Ser Tyr Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile  
100 105 110

Lys

<210> 91

<211> 372

<212> DNA

<213> artificial sequence

87

&lt;220&gt;

&lt;223&gt; EpCAM 4-7 VH

&lt;400&gt; 91

gaggtgcagc tgctcgagca gtctggagct gagctggcga ggcctggggc ttcagtgaag 60  
 ctgtcctgca aggcttctgg ctacaccttc acaaactatg gtttaagctg ggtgaagcag 120  
 aggcttggac aggtccttga gtggattgga gaggtttatc ctagaattgg taatgcttac 180  
 tacaatgaga agttcaaggg caaggccaca ctgactgcag acaaatcctc cagcacagcg 240  
 tccatggagc tccgcagcct gacctctgag gactctgcgg tctatttctg tgcaagacgg 300  
 ggatcctacg atactaacta cgactgggtac ttcgatgtct ggggccaagg gaccacggtc 360  
 accgtctcct ca 372

&lt;210&gt; 92

&lt;211&gt; 124

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 4-7 VH

&lt;400&gt; 92

Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Ala Arg Pro Gly 1 5 10 15  
 Ala Ser Val Lys Leu Ser Cys Lys Ala Ser Gly Tyr Thr Phe Thr Asn 20 25 30  
 Tyr Gly Leu Ser Trp Val Lys Gln Arg Pro Gly Gln Val Leu Glu Trp 35 40 45  
 Ile Gly Glu Val Tyr Pro Arg Ile Gly Asn Ala Tyr Tyr Asn Glu Lys 50 55 60  
 Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser Ser Thr Ala 65 70 75 80  
 Ser Met Glu Leu Arg Ser Leu Thr Ser Glu Asp Ser Ala Val Tyr Phe 85 90 95  
 Cys Ala Arg Arg Gly Ser Tyr Asp Thr Asn Tyr Asp Trp Tyr Phe Asp 100 105 110  
 Val Trp Gly Gln Gly Thr Thr Val Thr Val Ser Ser 115 120

&lt;210&gt; 93

&lt;211&gt; 336

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 4-7 VL

&lt;400&gt; 93

```

gagctcgtga tgaccagac tccactctcc ctgcctgtca gtcttggaga tcaagcctcc      60
atctcttgca gatctagtca gagccttgta cacagtaatg gaaacaccta ttacattgg      120
tacctgcaga agccaggcca gtctccaaag ctctgatct acaaagtttc caaccgattt      180
tctgggggtcc cagacagggt cagtggcagt ggatcaggga cagatttcac actcaagatc      240
agcagagtgg aggctgagga tctgggaggt tattttctgct ctcaaagtac acatgttccg      300
tacacgttcg gaggggggac caagcttgag atcaaa                                336

```

&lt;210&gt; 94

&lt;211&gt; 112

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 4-7 VL

&lt;400&gt; 94

```

Glu Leu Val Met Thr Gln Thr Pro Leu Ser Leu Pro Val Ser Leu Gly
1          5          10          15
Asp Gln Ala Ser Ile Ser Cys Arg Ser Ser Gln Ser Leu Val His Ser
20          25          30
Asn Gly Asn Thr Tyr Leu His Trp Tyr Leu Gln Lys Pro Gly Gln Ser
35          40          45
Pro Lys Leu Leu Ile Tyr Lys Val Ser Asn Arg Phe Ser Gly Val Pro
50          55          60
Asp Arg Phe Ser Gly Ser Gly Ser Gly Thr Asp Phe Thr Leu Lys Ile
65          70          75          80
Ser Arg Val Glu Ala Glu Asp Leu Gly Val Tyr Phe Cys Ser Gln Ser
85          90          95
Thr His Val Pro Tyr Thr Phe Gly Gly Gly Thr Lys Leu Glu Ile Lys
100          105          110

```

<210> 95  
 <211> 360  
 <212> DNA  
 <213> artificial sequence

<220>

<223> EpCAM 5-10 VH

<400> 95

```

gagggtgcagc tgctcgagca gtctggagct gagctggtaa ggcctgggac ttcagtgaag      60
atatacctgca aggcttctgg atacgccttc actaactact ggctagggttg ggtaaagcag      120
aggcctggac atggacttga gtggattgga gatattttcc ctggaagtgg taatatccac      180
tacaatgaga agttcaaggg caaagccaca ctgactgcag acaaatcttc gagcacagcc      240
tatatgcagc tcagtagcct gacatttgag gactctgctg tctatttctg tgcaagactg      300
aggaactggg acgagcctat ggactactgg ggccaaggga ccacgggtcac cgtctcctca      360
  
```

<210> 96  
 <211> 120  
 <212> PRT  
 <213> artificial sequence

<220>

<223> EpCAM 5-10 VH

<400> 96

```

Glu Val Gln Leu Leu Glu Gln Ser Gly Ala Glu Leu Val Arg Pro Gly
1           5           10           15
Thr Ser Val Lys Ile Ser Cys Lys Ala Ser Gly Tyr Ala Phe Thr Asn
           20           25           30
Tyr Trp Leu Gly Trp Val Lys Gln Arg Pro Gly His Gly Leu Glu Trp
           35           40           45
Ile Gly Asp Ile Phe Pro Gly Ser Gly Asn Ile His Tyr Asn Glu Lys
           50           55           60
Phe Lys Gly Lys Ala Thr Leu Thr Ala Asp Lys Ser Ser Ser Thr Ala
65           70           75           80
Tyr Met Gln Leu Ser Ser Leu Thr Phe Glu Asp Ser Ala Val Tyr Phe
           85           90           95
  
```

90

Cys Ala Arg Leu Arg Asn Trp Asp Glu Pro Met Asp Tyr Trp Gly Gln  
 100 105 110

Gly Thr Thr Val Thr Val Ser Ser  
 115 120

&lt;210&gt; 97

&lt;211&gt; 339

&lt;212&gt; DNA

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 5-10 VL

<400> 97  
 gagctcgtga tgacacagtc tccatcctcc ctgactgtga cagcaggaga gaaggctcact 60  
 atgagctgca agtccagtca gagtctgtta aacagtggaa atcaaaagaa ctacttgacc 120  
 tgggtaccagc agaaaccagg gcagcctcct aaactgttga tctactgggc atccactagg 180  
 gaatctgggg tccctgatcg cttcacaggc agtggatctg gaacagattt cactctcacc 240  
 atcagcagtg tgcaggctga agacctggca gtttattact gtcagaatga ttatagttat 300  
 ccgctcacgt tcggtgctgg gaccaagctt gagatcaaa 339

&lt;210&gt; 98

&lt;211&gt; 113

&lt;212&gt; PRT

&lt;213&gt; artificial sequence

&lt;220&gt;

&lt;223&gt; EpCAM 5-10 VL

&lt;400&gt; 98

Glu Leu Val Met Thr Gln Ser Pro Ser Ser Leu Thr Val Thr Ala Gly  
 1 5 10 15

Glu Lys Val Thr Met Ser Cys Lys Ser Ser Gln Ser Leu Leu Asn Ser  
 20 25 30

Gly Asn Gln Lys Asn Tyr Leu Thr Trp Tyr Gln Gln Lys Pro Gly Gln  
 35 40 45

Pro Pro Lys Leu Leu Ile Tyr Trp Ala Ser Thr Arg Glu Ser Gly Val  
 50 55 60

Pro Asp Arg Phe Thr Gly Ser Gly Ser Gly<sup>91</sup> Thr Asp Phe Thr Leu Thr  
65 70 75 80

Ile Ser Ser Val Gln Ala Glu Asp Leu Ala Val Tyr Tyr Cys Gln Asn  
85 90 95

Asp Tyr Ser Tyr<sup>100</sup> Pro Leu Thr Phe Gly<sup>105</sup> Ala Gly Thr Lys Leu<sup>110</sup> Glu Ile

Lys

<210> 99

<211> 15

<212> PRT

<213> artificial sequence

<220>

<223> standard linker

<400> 99

Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser  
1 5 10 15

<210> 100

<211> 47

<212> DNA

<213> artificial sequence

<220>

<223> 4-7 VL BspEI FOR

<400> 100

ctgaaatccg gaggtggtgg atccgagctc gtgatgaccc agactcc

47

<210> 101

<211> 52

<212> DNA

<213> artificial sequence

<220>

<223> 4-7 VL GS15 REVs148

<400> 101



ggagccgccg ccgccagaac caccaccacc ttgatctca agcttggtcc cc

# INTERNATIONAL SEARCH REPORT

In International Application No  
PCT/EP2004/005687

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C07K16/30 C07K16/28 A61K39/395 A61K16/46

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C07K A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPO-Internal, WPI Data, PAJ, EMBASE, BIOSIS, MEDLINE, Sequence Search

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 99/25818 A (KUFR PETER ; RAUM TOBIAS (DE); ZETTL FLORIAN (DE); BORSCHERT KATRIN) 27 May 1999 (1999-05-27) the whole document	1-25
Y	WO 00/03016 A (CONNEX GMBH ; REITER CHRISTIAN (DE)) 20 January 2000 (2000-01-20) the whole document	1-25
Y	WO 01/71005 A (HOFMEISTER ROBERT ; RIETHMUELLER GERT (DE); KISCHEL ROMAN (DE); KUFR) 27 September 2001 (2001-09-27) the whole document	1-25

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*&\* document member of the same patent family

Date of the actual completion of the international search

21 October 2004

Date of mailing of the international search report

04/11/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Irion, A

# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/EP2004/005687

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 00/06605 A (KUFR PETER ; ZETTL FLORIAN (DE); DREIER TORSTEN (DE); BAEUERLE PATRIC) 10 February 2000 (2000-02-10) the whole document	1-25
A	JOHNSON GEORGE ET AL: "Preferred CDRH3 lengths for antibodies with defined specificities" INTERNATIONAL IMMUNOLOGY, vol. 10, no. 12, December 1998 (1998-12), pages 1801-1805, XP002302009 ISSN: 0953-8178 the whole document	6,8
A	RAUM TOBIAS ET AL: "Anti-self antibodies selected from a human IgD heavy chain repertoire: A novel approach to generate therapeutic human antibodies against tumor-associated differentiation antigens" CANCER IMMUNOLOGY IMMUNOTHERAPY, vol. 50, no. 3, May 2001 (2001-05), pages 141-150, XP002301913 ISSN: 0340-7004 the whole document	1-25

# INTERNATIONAL SEARCH REPORT

In ☐ International Application No  
PCT/EP2004/005687

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9925818	A	27-05-1999	AU 1873199 A	07-06-1999
			CA 2309679 A1	27-05-1999
			WO 9925818 A1	27-05-1999
			EP 1032660 A1	06-09-2000
			JP 2002508924 T	26-03-2002
WO 0003016	A	20-01-2000	AU 767443 B2	13-11-2003
			AU 4909199 A	01-02-2000
			CA 2335090 A1	20-01-2000
			CN 1308675 T	15-08-2001
			WO 0003016 A1	20-01-2000
			EP 1097210 A1	09-05-2001
			ID 28117 A	03-05-2001
			JP 2002520021 T	09-07-2002
			NO 20010148 A	09-03-2001
			NZ 509232 A	31-10-2003
			TR 200100039 T2	21-05-2001
WO 0171005	A	27-09-2001	AU 6015301 A	03-10-2001
			CA 2406993 A1	27-09-2001
			CN 1423700 T	11-06-2003
			CZ 20023203 A3	13-08-2003
			WO 0171005 A2	27-09-2001
			EP 1266014 A2	18-12-2002
			HU 0300919 A2	28-07-2003
			JP 2004500108 T	08-01-2004
			NO 20024489 A	19-11-2002
			PL 358215 A1	09-08-2004
			US 2004038339 A1	26-02-2004
WO 0006605	A	10-02-2000	AT 251181 T	15-10-2003
			AU 5728999 A	21-02-2000
			DE 69911793 D1	06-11-2003
			DE 69911793 T2	12-08-2004
			DK 1100830 T3	19-01-2004
			WO 0006605 A2	10-02-2000
			EP 1100830 A2	23-05-2001
			ES 2207278 T3	16-05-2004
			JP 2002521053 T	16-07-2002

**This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record.**

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINE(S) OR MARK(S) ON ORIGINAL DOCUMENT**
- ☒ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☒ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**